APPENDIX O

Biological Assessments

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National Marine Fisheries Service

Biological Assessment – Section 7

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ACRONYMS AND ABBREVIATIONS

%......................Percent
μPa...................micropascal
AAC.................Alaska Administrative Code
ACC.................Alaska Coastal Current
ADEC...............Alaska Department of Environmental Conservation
bbl....................barrels
Bbbl..................billion barrels
CFR..................Code of Federal Regulation
CWA................Clean Water Act
dB.....................decibel
Donlin Gold.....Donlin Gold, LLC
DPS..................distinct population segments
EPA..................U.S. Environmental Protection Agency
ESA..................Endangered Species Act
FRP..................Facility Response Plans
ft.......................foot/feet
h.......................hour
Hz.....................hertz
kHz...................kilohertz
km....................kilometer
kt......................knot/knots
m......................meter
mi.....................statute mile
MSGP...............Multi-sector General Permit
NMFS...............National Marine Fisheries Service
ODPCP.............oil discharge prevention and contingency plan
PTS...................permanent threshold shift
r........................radius
RHA.................Rivers and Harbors Act
rms...................root mean square
TRB..................Transportation Research Board
TSS...................Traffic Separation Scheme
TTS..................temporary threshold shift
U.S...................United States
USACE............U.S. Army Corps of Engineers
USFWS............U.S. Fish and Wildlife Service
USCG...............U.S. Coast Guard
WQS.................Water Quality Standards

1. INTRODUCTION

In July 2012, Donlin Gold submitted a preliminary permit application, as per Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act (CWA), to the U.S. Army Corps of Engineers (USACE) to develop an open pit, hardrock gold mine approximately 10 miles (mi) (16 kilometers [km]) north of the village of Crooked Creek, in western Alaska. The proposed Donlin Gold Project has four primary components: 1) mine site facilities, 2) a 315-mi (507-km) natural gas pipeline, 3) oceanic supply barging, and 4) river supply barging. All barging will occur in the ice free months from May to September. The marine barging components of the project could encounter species listed under the Endangered Species Act (ESA) at locations described in this report.

Fifteen species under ESA jurisdiction of the National Marine Fisheries Service (NMFS) are evaluated in this Biological Assessment (BA) on the potential and magnitude of effect of barging activities to each of the listed species. Activities of the proposed project that could affect the listed species include: noise from vessel propulsion, vessel strikes, accidental spill, incidental spill, and effects to prey. This BA also provides substantial detail on the listed species distribution, feeding, reproduction, natural mortality, and use of the proposed action area, all of which are necessary to conduct the detailed effects analysis.

2. ACTION AREA AND LOGISTICS

The Donlin Gold Project action area includes the following proposed project components: mine site; natural gas pipeline; access road; Jungjuk Port; river transportation route; and the marine barging routes. Only the marine barging routes are addressed in this BA as they are the only Project component intersecting habitat used by species under the ESA. The marine barging routes extend from the mouth of the Kuskokwim River, in Kuskokwim Bay, to sea ports in Dutch Harbor and Seattle. This action area is very broad and larger than the scope used in the analyses included in the Draft Environmental Impact Statement. NMFS conformity with this action area has not taken place pending the start of future informal consultation. Thus this action area could change in the future. Changes in the action area could increase or decrease the number of potentially affected species addressed in this biological assessment.

Donlin Gold's proposed oceanic barging program consists of four marine barging routes as described:

1. **Pacific Offshore Route**: a 2,100-mi (3,380-km) barge route between Seattle and Unimak Pass following the Great Circle route (Figure 1a and Figure 1b),
2. **Pacific Inshore Route**: a 2,400-mi (3,862-km) route between Seattle and Unimak Pass following an inside passage route (Figure 2a, Figure 2b, Figure 2c, and Figure 2d),
3. **Bering Route**: a 520-mi (837-km) route between Dutch Harbor and the Kuskokwim River that includes the 470-mi (756-km) route between Unimak Pass and the Kuskokwim (Figure 3), and
4. **Cook Inlet Route**: a 40-mi (64-km) supply barge route between Anchorage and a barge landing south of Beluga (Figure 4).

The Pacific Offshore Route includes the marine inland waters of Washington State, and nearshore and offshore marine waters in the North Pacific and the Gulf of Alaska, while the Pacific Inshore Route follows inland and shelf waters from Puget Sound, through the inside passage, and inshore of Kodiak Island and the Shumagin Islands. The route is evaluated with Seattle as the launch point, although some cargo barges may launch from Vancouver (lessening the Pacific Inshore route by 120 mi [193 km]). The Bering Route includes the harbor waters of Dutch Harbor, and Bristol and Kuskokwim bays within the Bering Sea. Route lines in the figures are the best approximation of the routes to be followed. Actual routes may vary from those depicted in the figures, but not appreciably enough to alter the effects analysis results presented in this assessment.

Barging of cargo from the west coast ports will occur between May and September when all waters are clear of ice, and seasonal storms have abated. Barging will take place over the estimated 4 years of mine construction and the 27.5 years of operation. During operations three sets of cargo barges launching from Seattle or Vancouver will make approximately 12 trips (24 transits) annually, each round-trip taking about 32 days. Each barge will have a deadweight capacity of 11,500 tons (10,433 tonnes) and a net cargo capacity of 9,480 tons (8,600 tonnes), and will be hawser-towed by a 4,200-horsepower oceanic tugboat. Cargo will include annual consumables and general cargo consolidated as bulk in containers, bulk in super-sacks, loose or palletized break-bulk, small packages, and liquid in small tanks. Included in this cargo are a number of chemicals required in gold processing. The list and annual amount of chemicals that will be transported to and from the mine are found in Table 1.

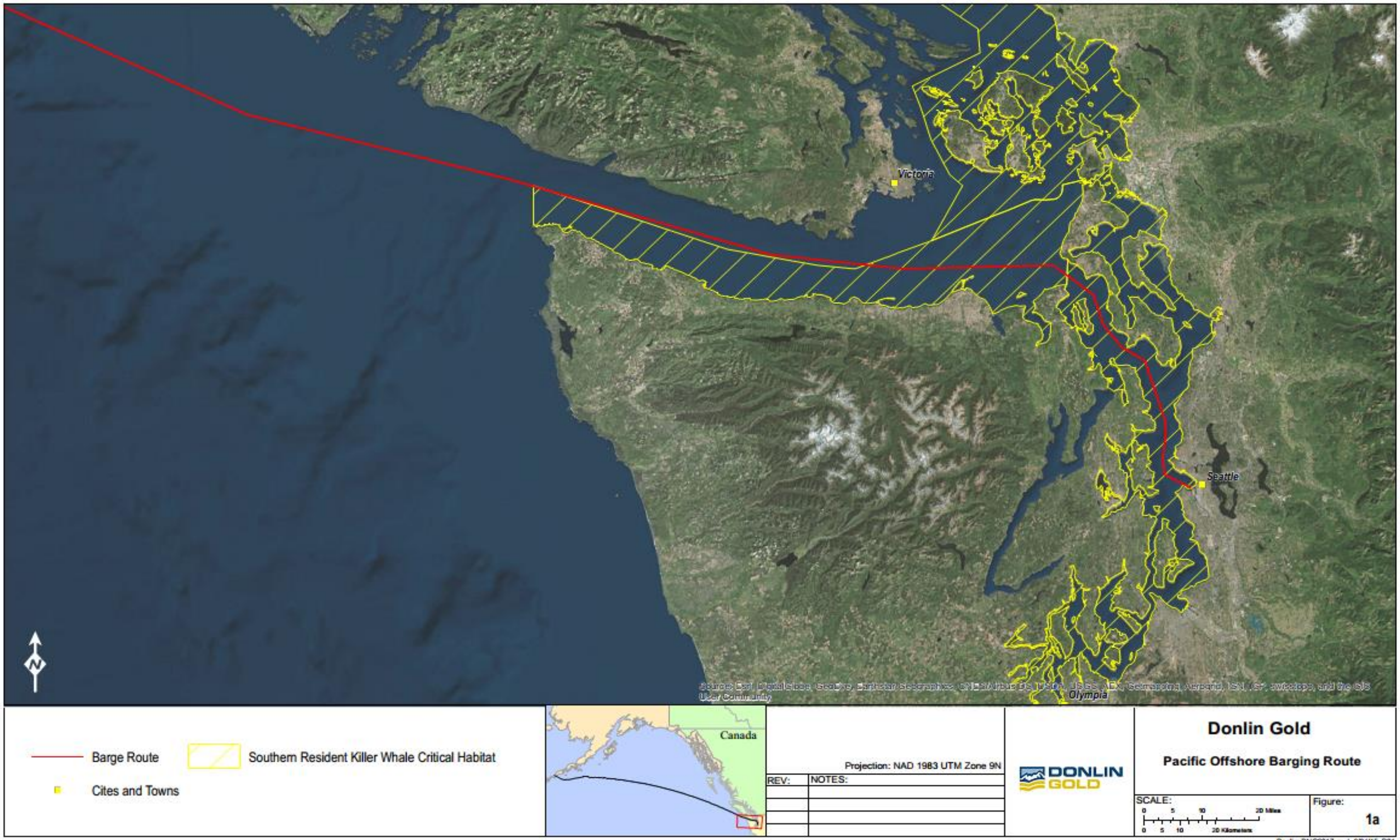

FIGURE 1A: PACIFIC OFFSHORE BARGING ROUTE

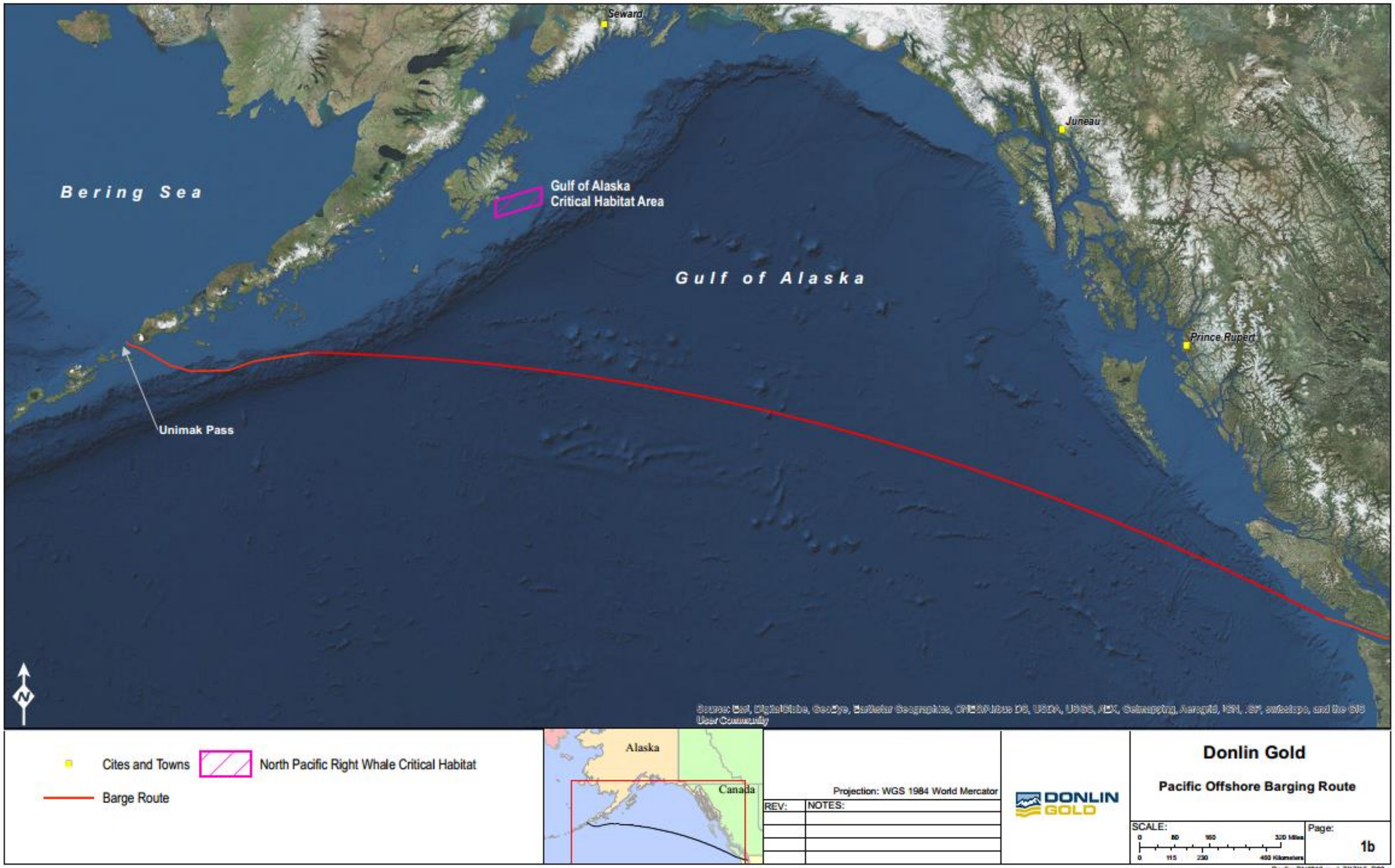

FIGURE 1B: PACIFIC OFFSHORE BARGING ROUTE

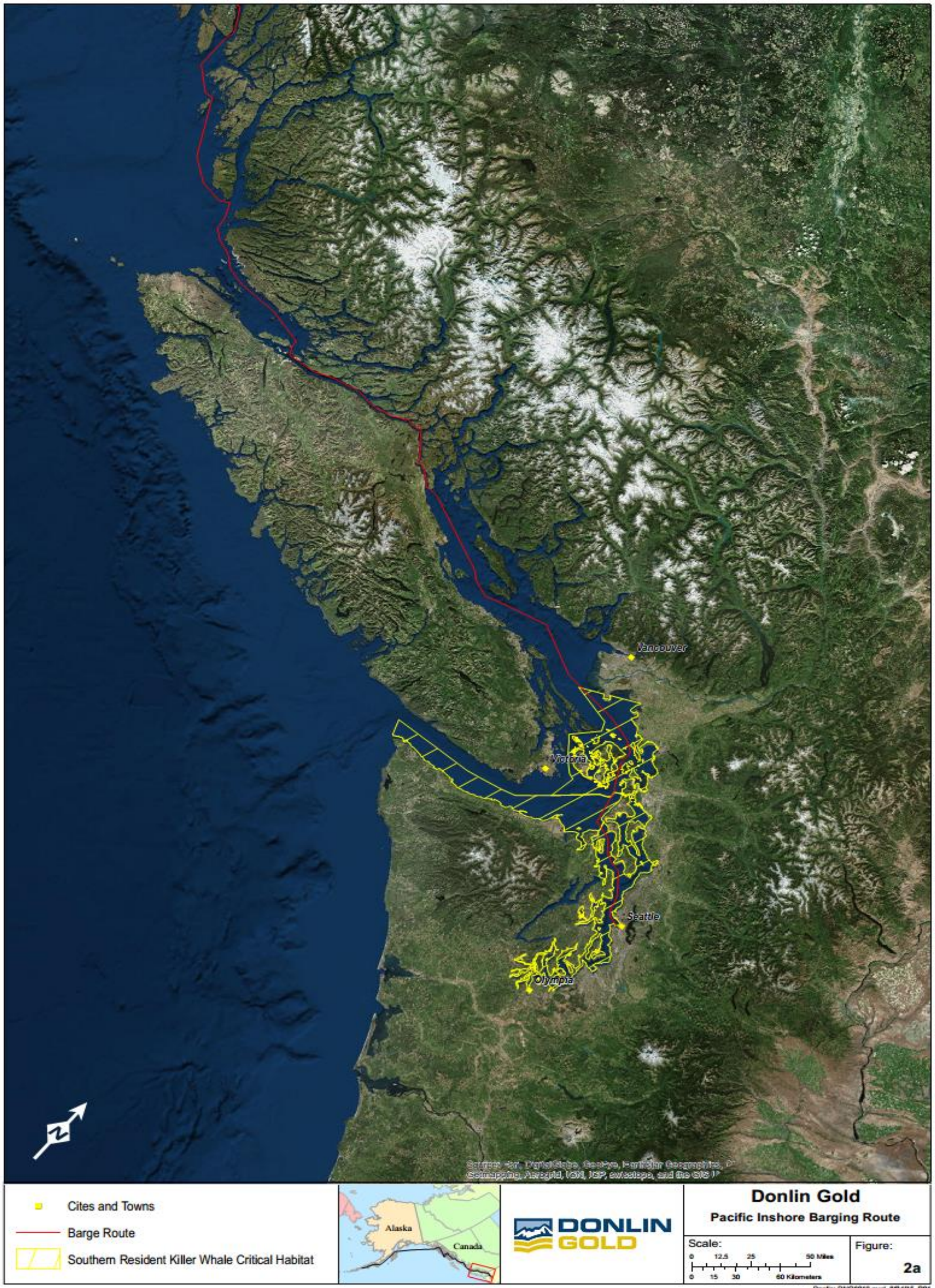

FIGURE 2A: PACIFIC INSHORE BARGING ROUTE

FIGURE 2B: PACIFIC INSHORE BARGING ROUTE

FIGURE 2C: PACIFIC INSHORE BARGING ROUTE

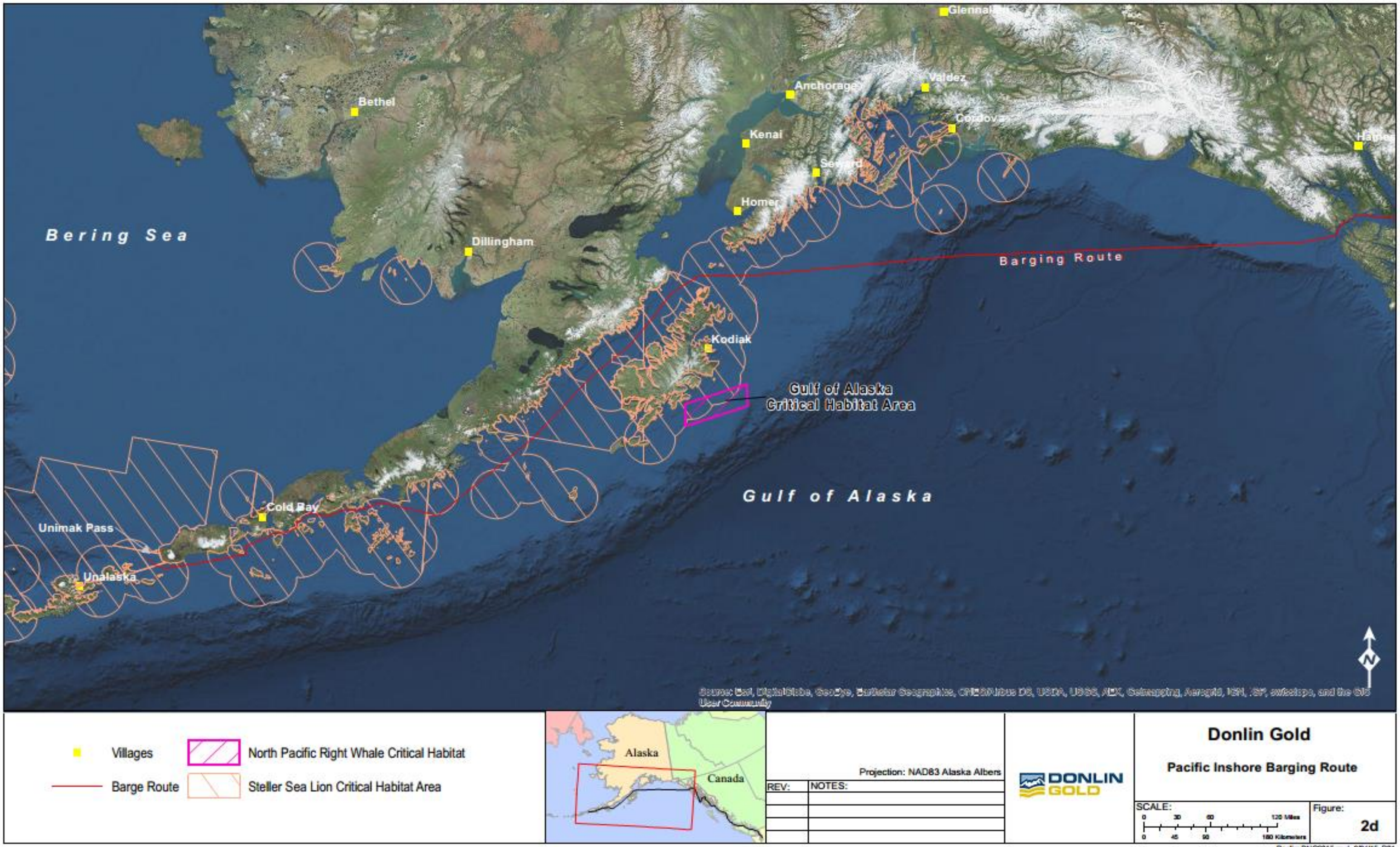

FIGURE 2D: PACIFIC INSHORE BARGING ROUTE

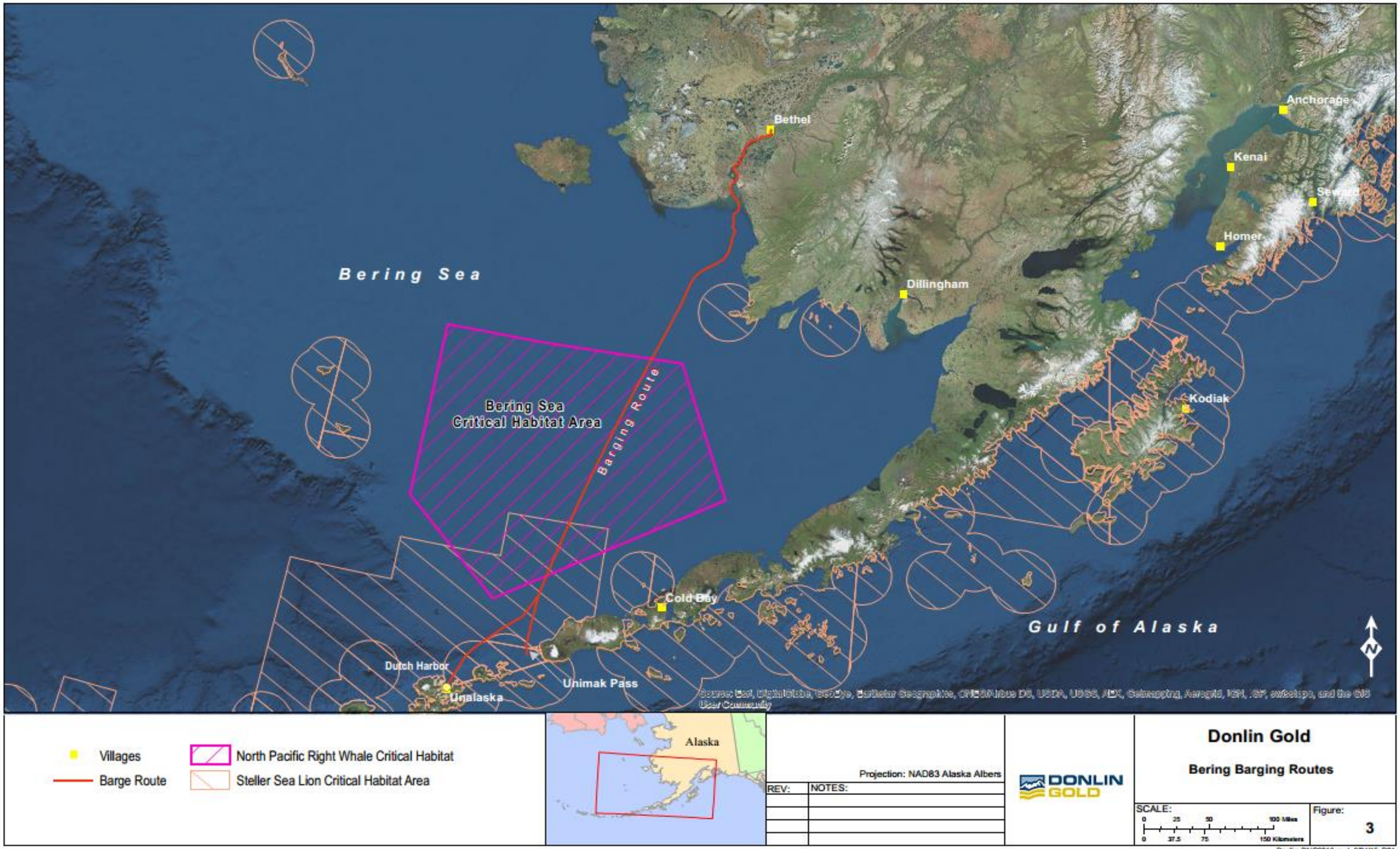

FIGURE 3: BERING BARGING ROUTES

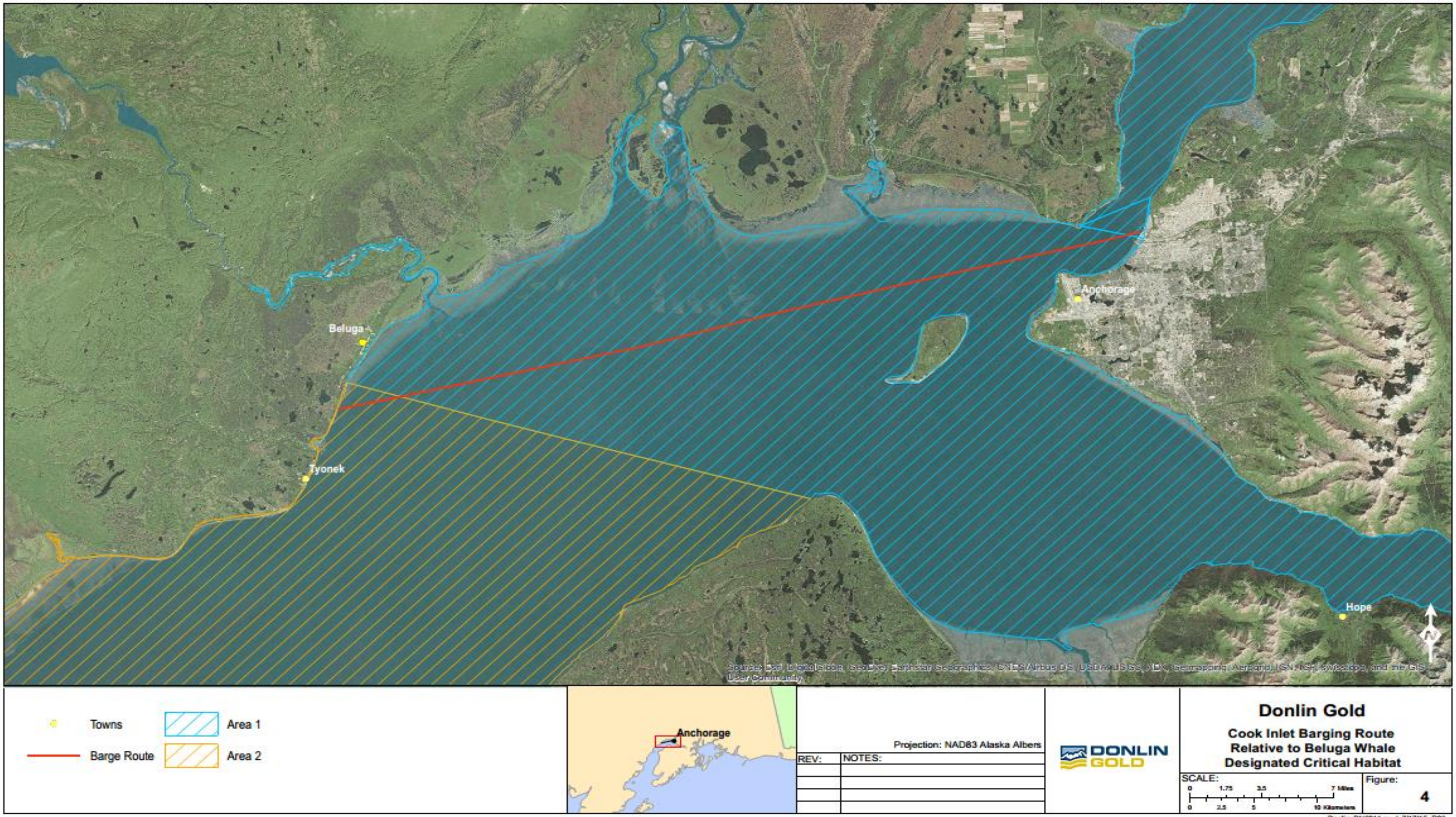

FIGURE 4: COOK INLET BARGING ROUTE RELATIVE TO BELUGA WHALE DESIGNATED CRITICAL HABITAT

TABLE 1: KEY CHEMICALS TRANSPORTED ANNUALLY DURING MINE OPERATION PHASE.

Chemicals[1]	Estimated Annual Transport (Short Tons)
Ammonium Nitrate (bulk)	33,000
Potassium Amyl Xanthate	4,189
Methyl Isobutyl Carbinol and F-549	1,984
Nitric Acid	661
Sodium Cyanide	2,535
Lime	21,027
Activated Carbon	220
Caustic soda (Sodium hydroxide)	358
Mercury Suppressant (UNR 829)	44
Flocculants	3,527
Sulfur	1,414
Copper sulfate	2,425
Fluxes (borax, sodium nitrate, and silica sand)	165
Water Softening and Anti-Scalant Agents[2]	1,081
Ferric Sulphate[3]	440
Sulphuric Acid[3]	18
Sodium hydroxide[3]	13
Polymer[3]	2
Potassium Permangenate[3]	13
Sodium Metabisulfite[3]	7
Cleaning-In-Place (HCl, NaOH)[3]	Less than 1 (~ 250 lbs)
Microsand[3]	8
Liquid Elemental Mercury	11
Spent Activated Carbon (Mercury)	5.5

[1]-The estimates are based on the current level of engineering design, and are applicable only to the mine operations phase. These chemicals would not be required during construction or the reclamation and closure phase of the project. The list of chemical amounts is subject to change along with future engineering design. Additional chemicals could/would be added, substituted, or amounts increased or decreased.
[2]- Includes 17 short tons of Anti-Scalant Agent required for the Advanced Water Treatment (AWT) .
[3]- Required for AWT.

During operations, fuel will be transported from Dutch Harbor to Bethel using a single double-hulled barge holding up to 2.9 million U.S. gallons of fuel, towed by a 3,000-horsepower tug. Fuel demand varies over the mine life, but at the peak of operations will require a maximum of about 14 annual barge trips across Kuskokwim Bay. Fuel demands during construction are significantly lower and would require between 3 and 6 trips over the three- to four-year construction period.

Up to 20 construction barge trips (40 transits) will run from Anchorage to Beluga, but all trips will occur within one construction season, and gas line pipe will be the primary cargo. The beach landing site is 3.8 mi (6.1 km) south of the Beluga Airport and 7.3 mi (11.7 km) south of the mouth of the Beluga River.

3. SPECIES POTENTIALLY AFFECTED

The Cook Inlet Route bisects both summer (Area 1) and winter (Area 2) designated critical habitat (Figure 4) for the endangered Cook Inlet beluga whale, a high profile species, but no other listed species are found in the vicinity of this route. In contrast, the approximate 2,400-mi (3,862-km) route between Seattle and Unimak Pass intersects marine habitat used year-round, seasonally, or occasionally by at least 13 species, stocks, or distinct population segments (DPS) of listed marine mammals and three listed sea turtles. The Bering Route includes habitat used by large whales and Steller sea lions, and seasonally by two listed ice seals. A complete list of these species and their status is found in Table 2. For several of these species presence within the immediate vicinity of a moving barge is remote either because of rarity in the action area (*e.g.*, sei whale, ribbon seal, and loggerhead turtle), or because of seasonal timing (*e.g.,* ringed seal and bearded seal). Other marine mammals are likely to be encountered at some point during operations especially along the Pacific Inshore Route. None of these species are found in the vicinity of the other Project components including the mine site, pipeline route, access roads, and river barging route; thus, this assessment focuses on only the marine barging routes.

TABLE 2: LISTED MARINE MAMMALS AND SEA TURTLES POTENTIALLY OCCURRING ALONG DONLIN GOLD'S PROPOSED BARGING ROUTES

			Route			
Species	**Latin Name**	**ESA Status**	**Pacific Inshore**	**Pacific Offshore**	**Bering**	**Cook Inlet**
North Pacific Right Whale	*Eubalaena japonica*	Endangered	x		x	
Sei Whale	*Balaenoptera borealis*	Endangered		x		
Blue Whale	*Balaenoptera musculus*	Endangered		x		
Fin Whale	*Balaenoptera physalus*	Endangered	x	x	x	
Humpback Whale	*Megaptera novaeangliae*	Endangered	x		x	
Gray Whale WNP Stock	*Eschrichtius robustus*	Endangered			x	
Killer Whale SR Stock	*Orcinus orca*	Endangered	x			
Beluga Whale CI Stock	*Delphinapterus leucas*	Endangered				x
Sperm Whale	*Physeter catodon*	Endangered		x		
Steller Sea Lion Eastern DPS	*Eumetopias jubatus*	Threatened	x			
Steller Sea Lion Western DPS	*Eumetopias jubatus*	Endangered	x		x	
Ringed Seal	*Pusa hispida*	Threatened			x	
Bearded Seal	*Erignathus barbatus*	Threatened			x	
Leatherback Turtle	*Dermochelys coriacea*	Endangered	x	x		
Green Turtle	*Chelonia mydas*	Endangered	x	x		
Loggerhead Turtle	*Caretta caretta*	Threatened	x	x		

4. STATUS OF LISTED SPECIES

Sixteen ESA-listed species or DPS under the jurisdiction of the NMFS have been identified that could potentially occur along the four marine barging routes proposed for the Donlin Gold project (Table 2). The ESA status, biological status, and use of the action area of each are addressed below.

4.1. North Pacific Right Whale (*Eubalaena japonica*)

4.1.1. ESA Status

A primary target of the 19th Century whaling industry, worldwide right whale populations, including those in the North Pacific, were reduced to critically low levels by the early 20th Century. As many as 37,000 North Pacific right whales were taken between 1839 and 1909, with 80 percent (%) of these taken in the 1840s alone (Scarff 2001). They were first protected under an international agreement in 1935, although Japan and the Soviet Union did not sign the original agreement and continued hunting these whales well into the 1960s, either illegally or as "scientific" research. In 1970, North Pacific right whales were afforded additional protection under the Endangered Species Conservation Act, the precursor to the Endangered Species Act of 1973. They are currently listed as endangered under the ESA.

Critical habitat was designated for this species in 2006. At that time, the whale was classified as the North Pacific population of the northern right whale (*Eubalaena glacialis*). In 2008, it was reclassified as the North Pacific right whale (*E. japonica*). Two areas were designated, the 35,780-square-mi (92,670 square-km) Bering Sea Critical Habitat Area located north of the Alaska Peninsula (Figure 3) and the smaller Gulf of Alaska Critical Habitat Area found south of Kodiak Island (Figure 2d). A final Recovery Plan was published in June 2013.

4.1.2. Biological Status

4.1.2.1. Abundance and Trends

Two separate populations of North Pacific right whales have been identified: a western population of about 400 whales that summers in the Sea of Okhotsk and winters off the coasts of China and Japan, and an eastern population of about 30 whales that summers in the Bering Sea and migrates along the western coast of the United States (U.S.) to Baja, California. Although neither of the aforementioned population estimates have been validated, they still represent a fraction of the tens of thousands of whales that once inhabited the North Pacific (Scarff 2001). The limited data on population abundance is insufficient to determine trends.

4.1.2.2. Distribution and Habitat Use

The potential historic range of the North Pacific right whale included the entire North Pacific with greater use in the eastern and western North Pacific and less use in the central North Pacific (Clapham *et al*. 2004). Nineteenth Century whaling efforts concentrated on the Gulf of Alaska, Bering Sea, and the Sea of Okhotsk. The several hundred whales that were illegally or "scientifically" killed by Russian and Japanese whalers in the 1960s were also taken in these areas. Winter calving grounds or migration routes (Waite *et al*. 2003) are largely unknown based on the paucity of sightings, although the waters offshore of Southern California and northwest of the Hawaiian Islands have been identified as candidate wintering grounds based on winter habitat preferences of North Atlantic right whales (Good and Johnston 2009). Based on recent sightings, the Sea of Okhotsk, nearby Kamchatka Peninsula, the Bering Sea north of the Alaskan Peninsula, and Albatross Bank in the Gulf of Alaska south of Kodiak Island are the only known summer feeding grounds (Scarff 2001; Tynan *et al.* 2001; Brownell *et al*. 2001; Clapham *et al*. 2004; Wade *et al*. 2011a, b).

4.1.2.3. Feeding and Prey Selection

The preferred prey of North Pacific right whales is calanoid copepods. Diet studies from whales harvested in the 1960s by the Japanese revealed that whales in the Gulf of Alaska fed primarily on *Neocalanus cristatus*, while whales from the eastern Aleutian Islands contained mostly *N. plumchrus* (Omura 1958, 1986; Omura *et al*. 1969). A single net tow conducted in the vicinity of whales feeding on surface zooplankton over Albatross Bank found a mix of euphausiids and copepods that included *N. cristatus*, *N. plumchrus*, *N. flemingeri*, and *Calanus marshallae* (NMFS 2013, Wade *et al*. 2011b). Repeated sightings (3 consecutive years) of right whales presumably feeding at Albatross Bank suggest that the bank supports significant densities of zooplankton, leading to the designation of the bank as critical habitat (Gulf of Alaska Critical Habitat Area; Figure 2d).

4.1.2.4. Reproduction

Little is known about reproduction in North Pacific right whales. The sighting of a possible calf in the Bering Sea in 1996 (Goddard and Rugh 1998), and the observations of a few subadults (Wade *et al*. 2011b), indicate that at least limited breeding has occurred since cessation of Soviet whaling in the 1960s. However, the number of breeding females in the eastern North Pacific population is small, which combined with the low population, limits the ability for these whales to find viable mates (NMFS 2013). Based on Kraus *et al*. (2007), for North Atlantic right whales, the average age at first calving is 9 to 10 years and the calving interval is 3 to 5 years.

4.1.2.5. Natural Mortality

Natural mortality rate for North Pacific right whales is likely to be similar to that for North Atlantic right whales: 17% in yearlings and 3% in subadults based on photo-identification data (Kraus 1990), although specific causes are not fully known. Mortality from anthropogenic sources is likely lower for the North Pacific whales as fishing and shipping traffic is less intense than in the Atlantic habitats (NMFS 2013). Still, any anthropogenic mortality is serious given there may only be 30 whales in the eastern North Pacific population.

4.1.3. Species Use of the Action Area

A direct barging route between Unimak Pass or Dutch Harbor and Kuskokwim Bay would bisect the Bering Sea right whale critical habitat area (Figure 3), possibly leading to a barge encounter with individual summering right whales. If the entire North Pacific population of 30 right whales is present during barging across the 35,780-mi^2 (92,670 km^2) critical habitat area (1 whale per 1,200 mi^2 [3,108 km^2]), the expected encounter rate is low.

4.2. Sei Whale (*Balaenoptera borealis*)

4.2.1. ESA Status

The sei whale is listed as endangered under the ESA. Because of their pelagic distribution and fast swimming speed, they were one of the last species to be targeted by the commercial whaling industry. Approximately 300,000 sei whales were harvested worldwide, mostly during the modern whaling period, with a reported 61,500 taken in the North Pacific between 1947 and 1987 (Caretta *et al*. 2012). Tillman (1977) estimated that an original North Pacific population of 42,000 was reduced to between 7,260 and 12,620 animals by 1974. A couple of hundred sei whales were taken by shore-based whaling off California, and about 4,000 where killed off British Columbia, mostly between 1955 and 1969 (Gregr *et al*. 2000). Given the number of whales that remained at the cessation of whaling, and the time since then, some have speculated that the North Pacific population has grown and may no longer warrant ESA status. However, virtually no confirmed sei whale sightings have occurred off the west coast of the U.S. or British Columbia since the end of whaling, and Barlow (2010) estimated the current abundance off California, Oregon, and Washington at only 126. Although the sei whale's pelagic distribution would have seasonally included the Gulf of Alaska, Allen and Angliss (2014) did not include sei whales in the 2013 Alaska marine mammal stock assessment report. No critical habitat has been designated for this species, although an updated recovery plan was finalized in 2012.

4.2.2. Biological Status

4.2.2.1. Abundance and Trends

Other than Tillman's (1977) estimate of between 7,260 to 12,620 sei whales occurring in the North Pacific in 1974, there are no meaningful estimates based on recent surveys. Barlow (2010) estimated the U.S. west coast population at only 126, but this number is based on aerial and shipboard surveys that were conducted primarily over continental shelf waters, a habitat feature rarely used by this pelagic species. Without current abundance estimates, a trend in the population cannot be computed.

4.2.2.2. Distribution and Habitat Use

North Pacific sei whales are pelagic in their distribution, and their range has been described as anywhere south of the Aleutian Islands and north of a line connecting Baja California and Japan (NMFS 2011). In general, seasonal distribution of sei whales is unpredictable with sporadic "influxes" occurring at some locations (Clapham *et al.* 1997).

4.2.2.3. Feeding and Prey Selection

North Pacific sei whales feed on a variety of marine prey. They are unusual in that they will gulp-feed on schooling fish and euphausiids much like a humpback whale, but also skim feed at the surface on calanoid copepods similar to a right whale. Sei whales killed off California fed largely on anchovies (*Engraulis mordax*) and krill (*Euphausia pacifica*) (Rice 1977, Clapham *et al*. 1997).

4.2.2.4. Reproduction

Based on the sample of sei whales killed off Central California, Rice (1977) found these whales to sexually mature at about 10 years of age, with a 13-month gestation period and 3-year calving interval. The calving season extended from September to March.

4.2.2.5. Natural Mortality

Rice (1977) estimated the annual adult mortality rate at 8.8% for females and 10.3% for males.

4.2.3. Species Use of the Action Area

During the modern whaling period, sei whales seasonally concentrated in the shelf edge waters off Vancouver Island and Queen Charlotte Sound. More than 4,000 whales were taken from these waters during the mid-20th Century. The barging route from the Strait of Juan de Fuca to Unimak Pass would bisect this area. However, current sei whale use of this area is considered nearly non-existent. Either sei whales have moved their use of the area farther offshore away from coastal survey areas or the populations that were found there have been largely exterminated.

4.3. Blue Whale (*Balaenoptera musculus*)

4.3.1. ESA Status

Blue whales were first protected in the North Pacific in 1966 under the International Convention of the Regulation of Whaling and are currently listed as endangered under ESA. Nearly 10,000 blue whales were killed in the North Pacific between 1910 and 1965 (Ohsumi and Wada 1972), from an original population variously estimated at between 4,900 and 6,000 whales (Rice 1974, Omura and Ohsumi 1974). A recovery plan was finalized in 1998, but no critical habitat has been designated.

4.3.2. Biological Status

4.3.2.1. Abundance and Trends

Whaling data suggest the previous existence of five subpopulations (or stocks) of blue whales in the North Pacific (Reeves *et al*. 1998), with two – Aleutian Islands and eastern Gulf of Alaska – occurring in Alaska. Acoustical studies on whale call variation by Stafford (2001) support that there are separate northeastern North Pacific and northwestern North Pacific subpopulations (equivalent to Reeves *et al*.'s Aleutian Islands and eastern Gulf of Alaska subpopulations, respectively) with both stocks seasonally overlapping in the Gulf of Alaska (Stafford 2003). Photographs of a blue whale recently taken in the Gulf of Alaska matched with a Southern California whale (Calambokidis *et al*. 2009) resulting in NMFS designating all whales found from the Gulf of Alaska to the tropical eastern North Pacific as members of the Eastern North Pacific stock. Calambokidis *et al*. (2010) estimated this stock at 2,497 animals based on mark-recapture analysis of photographs collected from 2005 to 2008, and further estimated an annual growth rate of a little less than 3% per year. There are no estimates for the Western North Pacific stock.

4.3.2.2. Distribution and Habitat Use

Blue whales are cosmopolitan in their original distribution and inhabit both pelagic and shelf edge waters. Blue whales summering in Alaska were once speculated to winter in pelagic waters north of Hawaii (Berzin and Rovnin 1966). At least 1,380 blue whales were killed by shore-based whalers in British Columbia between 1908 and 1967 (Nichol *et al*. 2002), indicating the waters immediately offshore of Queen Charlotte Sound once supported a sizable summering blue whale population. Since 1997, 12 blue whales have been sighted off British Columbia. In July 2004, three blue whales were recorded between 100 and 150 mi (160 and 241 km) southeast of Prince William Sound, representing the first sightings in the region in over three decades (Calambokidis *et al*. 2009). Another three were recorded the same year, but in the western Aleutian Islands, and were acoustically matched with blue whales summering in the western North Pacific (Rankin *et al*. 2006). Stafford (2003) collected data from seafloor hydrophones and recorded blue whale calls from both eastern and western North Pacific populations in the Gulf of Alaska. It is unclear whether current observed use in Alaska is due to whales re-establishing old migration routes, or is a result of increased observer effort. However, Calambokidis *et al*. (2009) felt that the whales observed in the Gulf of Alaska in 2004 were members of the California feeding stock (which winters in tropical waters from Costa Rica to Baja) that had moved farther north that summer, perhaps because of inadequate feeding resources farther south. There are no reliable estimates of the Western North Pacific stock.

4.3.2.3. Feeding and Prey Selection

Blue whales are fairly selective in their feeding patterns with *E. pacifica*, a species of krill, universally dominating their diet (Rice 1986, Reeves *et al*. 1998).

4.3.2.4. Reproduction

The reproduction pattern of blue whales is similar to other large rorquals; the gestation is just less than 1 year, calving interval probably 2 to 3 years, and age at attainment of sexual maturity is thought to be between 5 and 15 years (Reeves *et al*. 1998).

4.3.2.5. Natural Mortality

Other than a few records of killer whales attacking blue whales (Tarpy 1979, Sears 1990), there is little information on natural mortality of these large cetaceans.

4.3.3. Species Use of the Action Area

The proposed Pacific Offshore barge route between Seattle and Unimak Pass crosses two areas where blue whales formerly concentrated and were actively hunted by modern whalers: Aleutians and offshore Vancouver Island/Queen Charlotte Sound. The Pacific Inshore route remains in shallow shelf waters where blue whales typically do not occur. The portion of the route crossing the northern end of the Gulf of Alaska between Southeast Alaska and Kodiak Island crosses shelf slope waters where blue whales were previously hunted and low numbers have recently been recorded (Stafford 2003, Calambokidis *et al*. 2009). The low number of blue whale sightings in these areas in the past several decades suggests that encounters with blue whales by offshore barging activities is remote. Of the approximately 2,500 blue whales comprising the eastern North Pacific population (Calambokidis *et al*. 2010), only a small fraction is known to travel north of California in summer, and the number of individuals from the western North Pacific population that ventures as far as the Alaska Peninsula or the Gulf of Alaska would be small given the low population and the distance from more productive western feeding areas. Thus, encounters with blue whales are possible anywhere in Pacific waters where the barge route crosses shelf slope or pelagic waters, although based on the low densities of this species in Alaskan waters, encounters are not expected.

4.4. Fin Whale (*Balaenoptera physalus*)

4.4.1. ESA Status

North Pacific fin whales were listed as endangered under the Endangered Species Conservation Act in 1970 and the ESA in 1973, and received full protection from commercial whaling in 1976 under the International Whaling Commission. Between 1925 and 1975, nearly 48,000 fin whales were harvested in the North Pacific (Chapman 1976). No critical habitat has been designated for the North Pacific fin whale, although a recovery plan was developed in 1998.

4.4.2. Biological Status

4.4.2.1. Abundance and Trends

Prior to commercial whaling, an estimated 25,000 to 27,000 fin whales seasonally inhabited the eastern North Pacific (Ohsuma and Wada 1974). By 1974, this stock was thought to have been reduced to between 38% and 50% of the original population (Rice 1974, Chapman 1976), although the methods used to estimate the decline may not be reliable (Barlow *et al.* 1994). Because this species occurs both in shelf edge and pelagic waters of the North Pacific, much of the population occurs outside nearshore marine mammal survey areas. Survey results from Moore *et al*. (2002) and Zerbini *et al*. (2006) were combined by Allen and Angliss (2014) to produce the current population estimate of 5,700 animals for western Alaskan waters. Zerbini *et al*. (2006) also estimated that this stock has increased at an annual rate of 4.8% since 1987. The California/Oregon/Washington stock has been estimated at 3,044 (Carretta *et al*. 2013) based on the combined surveys by Forney (2007) and Barlow (2010). This stock is also thought to be increasing (Barlow *et al.* 1994, Barlow 1997).

4.4.2.2. Distribution and Habitat Use

Fin whales are cosmopolitan in their distribution in that they are found in all the oceans of the world, including polar regions, although they are rare in the tropics and the Arctic Ocean. They are found in both pelagic and shelf waters, and especially use shelf edge upwelling and mixing zones. The migratory pattern of eastern North Pacific fin whales is not fully understood although they are found in Alaska during summer (Mizroch *et al*. 2009) and off California all year (Clapham *et al*. 1997).

4.4.2.3. Feeding and Prey Selection

Fin whales feed primarily on krill and schooling fish such as anchovies, Pacific herring (*Clupea pallasii*), and walleye pollock (*Theragra chalcogramma*) (Rice 1963, Clapham 1997). Euphausiids dominated the prey of fin whales taken from British Columbia whaling stations in the 1960s (Flinn *et al*. 2002).

4.4.2.4. Reproduction

It is assumed that North Pacific fin whales become sexually mature at about 10 years of age, although there is evidence that those in heavily exploited populations can mature in as little as 6 years (Gambell 1985, Ohsumi 1986). The calving interval may also vary depending on exploitation, with heavily hunted populations having intervals closer to 2 years (Christensen *et al*. 1992) and unhunted populations closer to 3 years (Agler *et al*. 1993).

4.4.2.5. Natural Mortality

There is little information on natural mortality. It is assumed that they are occasionally attacked by killer whales (*Orcinus orca*), but there is little evidence to confirm this.

4.4.3. Species Use of the Action Area

Fin whales could be found all along both Pacific barging routes, including within the Strait of Juan de Fuca, Gulf of Alaska, and both sides of Unimak Pass. However, encounters are probably most likely along the Pacific Offshore route when passing off shore of Vancouver Island and Queen Charlotte Sound (approximately a quarter of the Pacific Offshore route), a traditional fin whale feeding area, and when approaching the Alaskan continental shelf. Fin whales are more likely to be encountered along the Pacific Inshore route as it passes across the Gulf of Alaska, inside Kodiak Island through Shelikof Strait, and along coastal waters nearshore of the Alaska Peninsula. These are areas where Brueggeman *et al*. (1987, 1988) and Zerbini *et al*. (2006) found concentrations of feeding fin whales.

4.5. Humpback Whale (*Megaptera novaeangliae*)

4.5.1. ESA Status

The humpback whale, as with most great whales, was protected under international convention in 1966, although illegal whaling continued to occur well into the 1970s and possibly 1980s. They were listed as endangered under the Endangered Species Conservation Act in 1969, and again under the ESA in 1973, a designation that continues today. There is no designated critical habitat, but a recovery plan was finalized in 1991.

4.5.2. Biological Status

4.5.2.1. Abundance and Trends

There are numerous population estimates for North Pacific humpback whales depending on the survey and modeling techniques. An intensive 3-year (2004-2006) photo-identification study (Structures of Population, Levels of Abundance and Status of Humpback Whales; SPLASH) was conducted in an attempt to determine the population structure and abundance of North Pacific humpback whale populations (Calambokidis *et al*. 2008). The results of the study provided a best estimate overall abundance of 18,302 for the entire North Pacific, or an estimate higher than the pre-exploitation population estimated by Rice (1974). The SPLASH data (Calambokidis *et al*. 2008, Barlow *et al*. 2011) provided estimates for the three North Pacific humpback whale stocks occurring in the action area (see *Distribution and Habitat Use* below): California/Oregon/Washington stock - 2,034; Central North Pacific stock - 10,103; and Western North Pacific stock - 1,107. Combined, these three stocks represent 72% of the current North Pacific population. Since protection in 1966, the North Pacific population has grown at an annual rate of about 6% to 7% (Caretta *et al*. 2012).

4.5.2.2. Distribution and Habitat Use

Humpback whales are coastal in their habitat use, generally found in shelf edge, shelf, and inland waters. Three stocks of humpback whales inhabit the action area. The California/Oregon/Washington stock winters in the nearshore waters off Mexico and Central America, and summers off California, Oregon, and Washington. The Central North Pacific stock winters in Hawaiian waters and migrates to summer feeding areas in the coastal waters of British Columbia, Southeast Alaska, the Gulf of Alaska, the eastern Bering Sea, and the Aleutian Islands. The California/Oregon/Washington and Central North Pacific stocks overlap in southern British Columbia. The Western North Pacific stock winters off the coast of Asia and primarily summers in Russian waters, although it overlaps with the summer distribution of the Central North Pacific stock in the Bering Sea and along the Aleutians. Based on genetic analysis and movements of known animals, there appears to be little annual interchange between these three stocks. More than 5,000 humpback whales were taken by shore-based whalers off Vancouver Island between 1908 and 1967, and this region, plus Queen Charlotte Sound, remains an important humpback whale feeding ground (Nichol *et al*. 2002). Calambokidis *et al*. (2008) suggested that the whales using northern Washington and southern British Columbia waters might be a distinct stock.

4.5.2.3. Feeding and Prey Selection

For the most part, humpback whales prey on krill and schooling fish with the composition dependent on the feeding location. The most important prey off California are anchovies and the krill species *E. pacifica* (Rice 1963). This and other species of krill are important in Alaska along with Pacific herring (Frost and Lowry 1981, Krieger and Wing 1984). Nemoto (1957) found stomachs of humpbacks taken during Japanese whaling in the North Pacific to contain almost entirely euphausiids.

4.5.2.4. Reproduction

Humpback whale calving and breeding occurs on the warmer-watered wintering grounds. The high population growth rate (average annual rate of 6% -7%) since the 1960s is partially explained by a higher reproduction rate compared to other large whales. Females sexually mature at 4 to 6 years of age and gestation periods are less than 12 months (NMFS 1991). The calving interval is generally 2 to 3 years, but some whales have calved in consecutive years (NMFS 1991).

4.5.2.5. Natural Mortality

Identified natural mortality in the North Pacific has been limited to occasional killer whale predation, although red tide events and possibly parasite overload has been implicated in deaths of North Atlantic humpback whales (NMFS 1991). Killer whales have been observed killing humpbacks in Southeast Alaska (Dolphin 1987), and the rake marks on whale flukes have been attributed to killer whale attacks, although there is speculation that some marks are due to attacks on juveniles by false killer whales (*Pseudorca crassidens*) on Hawaiian wintering grounds (NMFS 1991).

4.5.3. Species Use of the Action Area

Encounters with humpback whales would be expected along the Pacific Offshore barging route when exiting Washington inland waters, paralleling Vancouver Island, and entering Unimak Pass. A few dozen humpback whales seasonally inhabit the Strait of Juan de Fuca, and the oceanic banks offshore of

Vancouver Island continue to support significant numbers of feeding whales. Surveys conducted by Zerbini *et al*. (2006) show that Unimak Pass and the surrounding islands are commonly used by humpback whales. However, the Pacific Inshore route, in particular, will intersect many of the major humpback whale feeding areas in British Columbia and Alaska, including inland waters of British Columbia and Southeast Alaska, the Barren Islands, and shelf waters south of the Alaska Peninsula (Zerbini *et al*. 2006), especially the Shumagin Islands (Brueggeman *et al*. 1987). Humpback whales also concentrate in the waters surrounding Unalaska Island (Dutch Harbor), which includes a portion of the Bering Sea fuel barging route.

4.6. Gray Whale - Western North Pacific Stock (*Eschrichtius robustus*)

4.6.1. ESA Status

The Eastern North Pacific stock of the gray whale was removed from the Endangered Species List (NMFS 1994) and is not addressed in this assessment. In contrast, the Western North Pacific stock includes only about 200 individuals (Weller *et al*. 2002), and is listed as endangered under the ESA.

4.6.2. Biological Status

Bradford *et al.* (2003) modeled the population parameters of the Western North Pacific stock of gray whale and estimated that the current population is only 8% to 9% of the original population, but does appear to be growing at or near its biologically maximum rate. This stock winters off Korea and southern Japan and summers in the Sea of Okhotsk or vicinity (Weller *et al*. 2002).

4.6.3. Species Use of the Action Area

While the unlisted Eastern North Pacific stock of gray whale inhabits portions of the proposed barging routes, the occurrence of the Western North Pacific stock in Alaska is putative. Weller *et al*. (2012) confirmed a few individuals of the Western North Pacific stock (photographed in the Sakhalin Islands on multiple occasions) were occasionally found wintering with the Eastern North Pacific stock in Mexico (Laguna San Ignacio). Presumably, this interchange included passage through Alaskan waters. However, there is no evidence that the distribution of these few individuals would overlap with the proposed Donlin Gold barging activities, especially since gray whale migration occurs outside the summer barging season. Thus, this species will not be discussed further in this assessment.

4.7. Killer Whale – Southern Resident Stock (*Orcinus orca*)

4.7.1. ESA Status

The distinct population segment (DPS) of Southern Resident killer whales was listed as endangered under the ESA in 2005 after it experienced a 20% decline from 1996 to 2001. It was also listed as endangered in Canada in 2003 under the Species at Risk Act (SARA). Critical habitat (over 2,500 mi^2 [6,475 square km]) in U.S. waters was designated in 2006, and additional critical habitat was identified for Canadian waters in 2008 (DFO 2008). This critical habitat includes nearly all the waters of Puget Sound, the Strait of Juan de Fuca, and the Strait of Georgia.

4.7.2. Biological Status

4.7.2.1. Abundance and Trends

From the time censuses began in 1974, the Southern Resident killer whale stock has fluctuated. Between 1974 and 1993 the stock increased from 71 to 96 animals (Ford *et al*. 1994), reaching a peak of 99 individuals in 1995. Over the next 6 years the population declined to 79 animals (Caretta *et al*. 2012), prompting legislative action resulting in the DPS becoming listed in 2005. Since 2001 the population has continued to fluctuate between 80 and 90 whales with the 2013 population at 84. L-Pod, the largest of the three Southern Resident pods, peaked at 60 whales in 1992, but has remained close to 40 animals over the last decade. Based on current trends, it is not likely that NMFS' 2020 recovery target of 95 individuals will be achieved.

4.7.2.2. Distribution and Habitat Use

Killer whales in general have the greatest worldwide distribution of any cetacean (NMFS 2008a). In the eastern North Pacific, killer whales come in three forms: resident whales, which inhabit the inland waters of Alaska, British Columbia, and Washington and feed primarily on salmon; transient whales, which inhabit coastal and inland waters and feed primarily on other marine mammals; and offshore whales, which live in pelagic waters and eat primarily sharks (Ford *et al*. 1994). Southern Resident killer whales inhabit the Salish Sea, which includes Puget Sound, the Strait of Juan de Fuca, the waters around the San Juan Island, Haro Strait, and the southern end of the Strait of Georgia. The designated critical habitat (U.S. and Canada) for this species was delineated based on this distribution. Southern Resident pods occasionally venture outside the Strait of Juan de Fuca into coastal waters ranging from Southeast Alaska to Southern California (Caretta *et al*. 2012), as well as north into habitat primarily used by Northern Resident killer whales.

4.7.2.3. Feeding and Prey Selection

Killer whales feed on a variety of prey, from other marine mammals to fish depending on the killer whale type. Resident killer whales feed almost exclusively on fish and squid (Scheffer and Slipp 1948, Ford and Ellis 2006), with 97% of the diet of both Northern and Southern Resident whales composed of salmon (Hanson *et al*. 2005, Ford and Ellis 2006). Chinook salmon (*Oncorhynchus tshawytscha*) alone has been found to comprise more than 78% of the Southern Resident diet (Hanson *et al*. 2005, Ford and Ellis 2006). Estes *et al*. (1998) discusses the importance of killer whale predation to ocean ecosystems.

4.7.2.4. Reproduction

Killer whales are relatively long-lived cetaceans (maximum age to 80-90 years; Olesiuk *et al*. 2005) with complex and stable social structures, and often defined and limited distributions. Consequently, they have low reproduction rates relative to other cetaceans, which may be density dependent (Dahlheim and Heyning 1999). Females generally do not first calve until about 14 years of age, gestation periods average about 17 months, and the calving interval ranges from 4.9 to 7.7 years (NMFS 2008a).

4.7.2.5. Natural Mortality

Natural sources of mortality are largely unknown (NMFS 2008a). There are no known predators other than humans (Baird 2001, Ford 2002), which is expected given that killer whales are an apex predator, although rare mass strandings may occur where whales become entrapped in shallow waters after the tide recedes (Reeves *et al*. 2002).

4.7.3. Species Use of the Action Area

All potential barging routes within Puget Sound, the Strait of Juan de Fuca (Pacific Offshore route), and the Strait of Georgia (Pacific Inshore route) fall within both U.S. and Canadian designated critical habitat for the Southern Resident killer whale. Visual encounters with these killer whales are likely at some point during the barging program.

4.8. Beluga – Cook Inlet Stock (*Delphinapterus leucas*)

4.8.1. ESA Status

The isolated Cook Inlet stock of the beluga whale was listed under the ESA as endangered in 2008 after declining from about 1,300 animals in 1979 (Calkins 1989) to an estimated 278 animals in 2005 (Allen and Angliss 2014). Subsistence harvest best explains the observed decline as approximately 10% to 15% of the stock was removed annually between 1994 and 1998. A conservation plan was finalized in 2008 and critical habitat was designated in 2011.

4.8.2. Biological Status

4.8.2.1. Abundance and Trends

The current abundance estimate for the Cook Inlet stock of beluga whale is 312 individuals. Since 2002, the population has continued to decline at a rate of about 0.6% annually (Allen and Angliss 2014).

4.8.2.2. Distribution and Habitat Use

Prior to the decline, this DPS was believed to range throughout Cook Inlet and occasionally into Prince William Sound and Yakutat (Nemeth *et al*. 2007). However the range has contracted coincident with the population reduction (Speckman and Piatt 2000). During summer and fall, beluga whales are concentrated near the Susitna River mouth, Knik Arm, Turnagain Arm, and Chickaloon Bay (Nemeth *et al*. 2007). Critical Habitat Area 1 (Figure 4) reflects this summer distribution. During winter, beluga whales concentrate in deeper waters in the mid-inlet to Kalgin Island, and in shallow water along the west shore of Cook Inlet to Kamishak Bay (Critical Habitat Area 2; Figure 4). Some whales may also winter in and near Kachemak Bay.

4.8.2.3. Feeding and Prey Selection

In the late spring and summer, Cook Inlet belugas concentrate in river mouths of upper Cook Inlet where they feed upon seasonal runs of eulachon (Hobbs *et al*. 2006) and salmon (Moore *et al*. 2000). During the remaining year they feed more on cod, sculpins, and flounders (NMFS 2008b).

4.8.2.4. Reproduction

Belugas become sexually mature at between 8 and 13 years of age (Burns and Seaman 1986). Gestation is 14 to 14.5 months (NMFS 2008b), and calving interval is 2 to 3 years (Sergeant 1973). Pregnancy rates are highest for the 12 to 21 age class (Burns and Seaman 1986). Published annual reproductive rates have ranged between 0.08 and 0.14 (NMFS 2008b). In Cook Inlet, most calving is thought to occur from mid-May to July (Calkins 1983).

4.8.2.5. Natural Mortality

Natural mortality includes stranding due to entrapment in shallow water from receding tides, and killer whale predation. However, most tidal strandings do not involve mortalities (Allen and Angliss 2014), and only four killer whale predation events were recorded between 1999 and 2008 (Shelden *et al*. 2003, Vos and Shelden 2005, Hobbs and Shelden 2008), and not all attacks were fatal.

4.8.3. Species Use of the Action Area

Cook Inlet belugas are largely confined to Cook Inlet proper and would not occur along any oceanic barging route between Seattle and Bethel. The Cook Inlet construction barging route between Anchorage and Beluga would intersect Area 1 critical habitat (Figure 4), including during the season of highest use of that habitat.

4.9. Sperm Whale (*Physeter catodon*)

4.9.1. ESA Status

Sperm whales were listed as endangered under the Endangered Species Conservation Act in 1969 and ESA in 1973. There is no designated critical habitat, but a recovery plan was finalized in 2010 (NMFS 2010). Although they remain the most abundant of all large whale species, sperm whales were afforded listing status based on population depletion due to commercial whaling.

4.9.2. Biological Status

4.9.2.1. Abundance and Trends

Rice (1989) estimated the North Pacific population prior to exploitation at 1,260,000. Based on Whitehead's (2002) model, the current North Pacific population is 152,000 to 226,000, although Croll *et al*. (2007) used Whitehead's data with a different model estimated the current population at only about 80,000, which would represent a 94% decline from Rice's (1989) pre-exploitation population. Although trend data are unavailable, the stock is likely continuing to increase since cessation of whaling (Carretta *et al*. 2012).

4.9.2.2. Distribution and Habitat Use

Sperm whales are cosmopolitan in their distribution and are exceeded only by killer whales in the extent of their range (NMFS 2010). Although sperm whales are found near the shelf edge, they are largely pelagic in distribution. Based on historical whaling records, whales were killed in Alaska and British Columbia in summer in deeper offshore waters, although most cows, calves, and immature bulls remained south of latitude 50°N (NMFS 2010). Of nearly 60,000 sperm whales killed in the North Pacific north of 50°N, approximately 57,000 were males (Mizroch and Rice 2006). Based on tagging studies, whales appear to annually move along the U.S. west coast into the Gulf of Alaska and the Aleutians (NMFS 2010). The 6,514 sperm whales killed off British Columbia between 1908 and 1967 were concentrated offshore of Vancouver Island with males found largely along the shelf edge and females more offshore (Nichol *et al*.

2002). Sperm whales are also often concentrated around oceanic islands and shelf edges where upwelling occurs.

4.9.2.3. Feeding and Prey Selection

Sperm whales feed on a variety of prey, although their diet is dominated by medium- and large-sized squids found at extreme water depths (NMFS 2010). Rice (1989) found mesopelagic fish to be important in the more northern latitudes.

4.9.2.4. Reproduction

Sperm whales first conceive at about age 9 (Rice 1989) and rarely become pregnant after age 40 (Whitehead 2003). The calving interval is fairly long at 4 to 6 years (Best *et al*. 1984). The longer interval is due in part to a gestation period of well over a year and a 2 year lactation period (Best *et al*. 1984). Females form social groups and during spring mating season are attended by roving mature bulls.

4.9.2.5. Natural Mortality

Killer whales have been observed attacking and killing sperm whales (Pitman and Chivers 1998), although killer whale predation appears to be a low mortality factor based on the rarity of observed attacks (NMFS 2010).

4.9.3. Species Use of the Action Area

Given the abundance of sperm whales in the eastern North Pacific, and their pelagic distribution, sperm whales are likely to be encountered along the Pacific Offshore route. Sperm whales are not expected along shallower shelf-waters of the Pacific Inshore route including the Gulf of Alaska, Bering Sea (*e.g.,* Bristol Bay), Cook Inlet, inside waters of Southeast Alaska and British Columbia, or inland waters of Washington State.

4.10. Steller Sea Lion (*Eumetopias jubatus*)

4.10.1. ESA Status

Due to substantial population declines in the western portion of its range, the Steller sea lion was first listed as threatened under the ESA in 1990, with critical habitat designated in 1993 (NMFS 2008c). In 1997, NMFS identified two DPSs, a Western and an Eastern, and reclassified the Western DPS as endangered based on persisting decline (NMFS 2008c). The Western DPS declined more than 80% between the late 1960s and 2000 at consistently monitored rookeries and haulout sites. Critical habitat includes a 20-nautical-mi buffer around all major haulouts and rookeries, and three large offshore foraging areas, within the area used by the Western DPS (Figure 3). A recovery plan was developed in 2008.

4.10.2. Biological Status

4.10.2.1. Abundance and Trends

The minimum abundance estimate for the western DPS of Steller sea lion, including Russian populations, is 45,916 animals based on pup and other count data collected between 2008 and 2011 (DeMaster 2011).

This is down from a 1950s population estimated for Alaska alone at 140,000 (Merrick *et al*. 1987). This DPS has grown at a slight 1.5% per year since 2000.

In contrast, the eastern DPS has increased at a 3% annual rate between the 1970s and 2002. Declines in the small number of Steller sea lions that inhabit central California have been offset by modest increases in northern California and Oregon, and more dramatic increases in Southeast Alaska and British Columbia. The current minimum population estimate is 52,847 (Caretta *et al*. 2012).

4.10.2.2. Distribution and Habitat Use

Steller sea lions are found in all Continental Shelf waters from central California, north to Alaska, through the Aleutian Islands to Kamchatka Peninsula, then south to northern Japan. Major haulout sites relative to the Donlin Gold barging activities occur from northern Vancouver Island (the Scotts Islands rookery supporting about 10,000 sea lions) almost continuously to the eastern Aleutian Islands in the vicinity of Unimak Pass and Unalaska (Dutch Harbor). In addition, about 1,000 Steller sea lions haul out along the outer coast of Washington with many seasonally occurring within inland waters of Washington where they regularly haul out on log booms and channel markers.

During summer Steller sea lions feed mostly over the continental shelf and shelf edge. Females attending pups forage within 20 nautical mi of breeding rookeries (Merrick and Loughlin 1997), which is the basis for designated critical habitat around rookeries and major haulout sites. During winter some of these sea lions may venture far out to sea in pursuit of prey (NMFS 2008c).

4.10.2.3. Feeding and Prey Selection

Steller sea lions are generalists feeding on a wide variety of fish and cephalopods (Calkins and Goodwin 1988). In Alaska and British Columbia schooling fish such as Pacific cod (*Gadus macrocephalus*), Pacific hake (*Merluccius productus*), walleye pollock (*Theragra chalcogramma*), Pacific herring, Pacific sand lance (*Ammodytes hexapterus*), squid, and salmon are of great importance, although rockfish are also important (Calkins and Goodwin 1988, Calkins 1998). Small schooling fish and salmon are eaten almost exclusively during summer, cod during winter, and pollock year-round (Merrick and Calkins 1996, NMFS 2008c).

4.10.2.4. Reproduction

Female Steller sea lions reach sexual maturity at 3 to 6 years of age and can continue to breed into their early 20s (Mathisen *et al*. 1962, Pitcher and Calkins 1981). Males are sexually mature at three to seven years of age, but are not physically mature enough to challenge for breeding rights until about 10 years of age (Thorsteinson and Lensink 1962, Pitcher and Calkins 1981, Raum-Suryan *et al*. 2002). Sexually mature females are capable of pupping annually, and studies in the 1970s and 1980s found early gestation pregnancy rates of 97% (NMFS 2008c). However, during periods consistent with nutritional stress, pregnancy will be terminated early (intrauterine mortality or premature birthing) (Calkins and Goodwin 1988). During the decline of the western DPS population in the 1970s and 1980s, pregnancy rates during late-term gestation dropped to between 55% to 67% (NMFS 2008c), and for lactating females, the late-term pregnancy rate was even lower suggesting that nursing compounds the energetic stress of reproduction during periods of low food availability. Females with better body conditions were more likely to maintain pregnancy (NMFS 2008c).

4.10.2.5. Natural Mortality

About 20% of a stable Steller sea lion population dies annually from natural mortality including trampling, disease, senescence, and killer whale predation (NMFS 2008a). Killer whales have been implicated as a possible factor for the observed sea lion decline, or at least as a limit preventing recovery. Williams *et al*. (2004) explained that the foraging demands of even a relatively few killer whales could account for high sea lion losses. However, other studies have shown that sea lions are a relatively small component of the diet of mammal-eating killer whales for the western DPS (6%-22%; Wade *et al*. 2007), and that killer whales using Kenai Fjords annually ate from 3% to 7% of the local sea lion population, or only about a quarter of the annual natural mortality (Maniscalco *et al*. 2007). A decline in the carrying capacity resulting in nutritional stress and lower reproduction rates remains the most viable explanation for the dramatic decline of the western DPS of Steller sea lions from the 1970s to the 2000s (NMFS 2008c).

4.10.3. Species Use of the Action Area

Steller sea lions are expected to occur all along the proposed oceanic Pacific and Bering barging routes, but most especially along the Pacific Inshore route between the Barren Islands and Unimak Pass. Along this inshore section, the route intersects the 20-nautical-mi designated critical habitat of at least five rookeries and 25 major haul out sites. The route also passes within 20 mi (32 km) of three major haulout sites in Southeast Alaska and near three haulout sites in British Columbia (although there are no 20-nautical-mi critical habitat buffers in Southeast Alaska and Canada), but not near any rookeries. The Pacific Offshore route through the Strait of Juan de Fuca passes within 6 mi (9.6 km) of three haulout sites on the rocks around Tatoosh Island on the U.S. side, and two haulout sites (Pachena Point and Carmanah Point) on the Canadian side (Jeffries *et al*. 2000). In addition, the Bering fuel barge route coming out of Dutch Harbor passes through critical habitat for two rookeries and two haulout sites, and all routes in the Bering Sea pass through the Bogoslof feeding area critical habitat. None of the routes pass within 1 nautical mi of any rookery. There is no Steller sea lion critical habitat in upper Cook Inlet.

4.11. Ice Seals

Two species of ice seals – ringed seals (*Pusa hispida*) and bearded seals (*Erignathus barbatus*) – seasonally occur in the Bering Sea. Both were listed under the ESA as threatened in December 2012 due the impact of declining sea ice on their long-term survival. Both species can be found in the southeastern Bering Sea, including Kuskokwim Bay, during winter periods when sea ice extends that far south (Cameron *et al*. 2010, Kelly *et al*. 2010). However, while their winter distribution spatially overlaps with a portion of the proposed Bering barging route, they do not temporally overlap. The oceanic barges proposed to be used for the Donlin Gold operations do not have the capability to travel in sea ice, and as a result their operation will be limited to the mid-May to September open-water period when ice seals are not present. Other than the possible lingering effects from a major oil spill (see *Consequences of Proposed Action*), there is no pathway for effects because the species and proposed actions occur at different times. Neither are, therefore, addressed further in this document. More information on these species can be found in the status reviews prepared by Kelly *et al*. (2010) for ringed seals and Cameron *et al*. (2010) for bearded seals during the ESA review process.

4.12. Leatherback Turtle (*Dermochelys coriacea*)

4.12.1. ESA Status

The leatherback turtle was initially listed as endangered in 1970 under the Endangered Species Conservation Act and again in 1973 under ESA. The shelf and shelf slope waters of Oregon and Washington north of Cape Blanco were designated critical habitat in 2012 based on observational (Bowlby *et al*. 1994) and telemetry studies (Benson *et al*. 2011) that showed large numbers of foraging leatherback turtles concentrate in these waters. The primary population threats leading to listing are human overharvest of eggs on the breeding beaches and incidental capture in fishing gear (NMFS and USFWS 1998a). Nesting populations in the Pacific have declined dramatically in the past three decades (Spotila *et al*. 2000, NMFS and USFWS 2013). A recovery plan was developed in 1998 (NMFS and USFWS 1998a).

4.12.2. Biological Status

4.12.2.1. Abundance and Trends

The Pacific population of leatherback turtles has declined dramatically in recent years. The nesting population along the Pacific coast of Mexico declined from greater than 10,000 in 1982 to about 120 nesting turtles by 2004 (Sarti Martinez *et al*. 2007). Although egg-harvest and fisheries bycatch have taken a toll on the eastern Pacific leatherback turtle population, food resources may be generally limited in the Pacific, especially during El Niño events, leading to observed declines in productivity (see NMFS and USFWS 2013).

4.12.2.2. Distribution and Habitat Use

Leatherback turtles, probably originating from Mexico but possibly from Indonesia as well, move north during summer warm-water periods into Oregon and Washington (Bowlby *et al*. 1994, Benson *et al*. 2011), and even to British Columbia (Spaven *et al*. 2009) and the Gulf of Alaska (Hodge and Wing 2000). Their preferred foraging habitat appears to be the outer continental shelf and shelf slope out to waters 6,560 ft (2,000 m) deep.

4.12.2.3. Feeding and Prey Selection

Various species of cnidarians (mainly jellyfish) and tunicates comprise the temperate latitude diet of leatherback turtles (NMFS and USFWS 1998a). Their mouthparts are designed to capture and hold gelatinous prey.

4.12.2.4. Reproduction

Female leatherback turtles annually lay clutches of about 100 eggs in dug pits on specific tropical beaches. Females may lay multiple clutches (average about six) in a given season, typically with nine- to eleven-day intervals between laying (NMFS and USFWS 1998a). Hatchlings emerge after about two months.

4.12.2.5. Natural Mortality

Leatherback turtles are the largest turtle in the world and as adults have few predators, although killer whales and large sharks might occasionally kill an adult. Juveniles, however, must run a gauntlet of beach predators (*e.g.*, crabs, frigatebirds) before reaching the ocean, and then are fed on by sharks, squid, and other large fishes.

4.12.3. Species Use of the Action Area

During late summer, leatherback turtles are likely to inhabit the southern portions of the Pacific Offshore barging route. However, given the dramatic recent decline in the eastern Pacific populations, encounters are likely to be rare.

4.13. Other Sea Turtles

Both the green (*Chelonia mydas*) and loggerhead (*Caretta caretta*) sea turtle were listed under ESA in 1978; the former as endangered and the latter as threatened. In 2011, NMFS up-listed the North Pacific DPS of loggerhead turtle as endangered. Both were listed due primarily to impacts to beach nesting habitat and from fisheries bycatch (NMFS and USFWS 1998b, c). Neither species nests on the west coast of the U.S., while records north of southern California are considered vagrants (NMFS 1998b, c). Although there have been strandings recorded as far north as Alaska (Bane 1992, Loshbaugh 1993), the proposed oceanic barging routes between Seattle and Bethel do not intersect recognized habitat for either species. Neither is, therefore, addressed further in this assessment.

5. CONSEQUENCES OF PROPOSED ACTION

Three activities proposed by the Donlin Gold Project's construction and operation have the potential to impact wildlife species under the jurisdiction of NMFS: Supply barging between Seattle and Bethel, fuel barging between Dutch Harbor and Bethel, and construction barging between Anchorage and Beluga. Pathways of potential effects include excessive noise generated by the tug propellers, ship strike, contamination from incidental spill of hazardous material, and contamination from an accidental oil spill due to rupture of a fuel tank or during fuel transfer. Each is addressed below.

5.1. Disturbance

Relative to marine mammals, man-made noise introduced into the marine environment can result in impaired hearing, disturbance of normal behaviors (*e.g.*, feeding, resting, social interactions), masking calls from conspecifics, disruption of echolocation capabilities, and masking sounds generated by approaching predators. Behavioral effects may be incurred at ranges of many miles, and hearing impairment may occur at close range (Madsen *et al*. 2006). Behavioral reactions may include avoidance of, or flight from, the sound source and its immediate surroundings, disruption of feeding behavior, interruption of vocal activity, and modification of vocal patterns (Watkins and Schevill 1975, Malme *et al*. 1984, Bowles *et al*. 1994, Mate *et al*. 1994). Long-term exposure can lead to fitness-reducing stress levels, and in some cases physical damage leading to death can occur (*e.g.*, Balcomb and Claridge 2001).

The hearing of baleen whales remains unmeasured, but anatomical analyses suggest they are low-frequency specialists with good sensitivity at less than 2 kilohertz (kHz) (Wartzok and Ketten, 1999). Odontocetes (toothed whales), however, are high-frequency specialists. For example, beluga have their best hearing sensitivity between 30 and 80 kHz (Finneran *et al*. 2005). Most pinnipeds have peak sensitivities between 1 and 20 kHz (NRC 2003), with phocids such as ringed and harbor seals peaking at over 10 kHz and showing good sensitivity to approximately 30 kHz (Wartzok and Ketten 1999). Also, pinniped sensitivity to underwater noise relates to their evolutionary adaptation to the underwater environment. Kastak and Schusterman (1998) found that northern elephant seals, which forage at great depths and spend prolonged periods underwater, have better underwater hearing sensitivity than in-air, while sea lions, which spend considerably more time at the surface or hauled out, exhibited the reverse.

Sea turtles have a relatively narrow, low frequency hearing range. Studies with Kemp's Ridley (*Lepidochelys kempi*), green, and loggerhead turtles indicate a hearing range of 100 to 1,000 hertz (Hz), with best sensitively in the 200 to 400 Hz range (Ridgway *et al*. 1969, Bartol *et al*. 1999, Ketten and Bartol 2005). Dow Piniak *et al*. (2012) measured underwater hearing in hatchling leatherbacks and found a hearing range of 50 to 1,200 Hz with maximum sensitivity in the 100 to 400 Hz range. These hearing frequencies overlap the dominant noise frequencies produced from cavitating propellers of working tugs (Richardson *et al*. 1995).

5.1.1. Threshold Shift

When exposed to intense sounds, the mammalian ear will protect itself by decreasing its level of sensitivity (shifting the threshold) to these sounds. Stereocilia are the sound sensing organelles of the middle and inner ear. They are the "hairs" of the hair cells that convert sound wave energy to electrical signals. When sound intensity is low, the hairs will bend towards the incoming waves, thereby increasing sensitivity. If the sound intensity is high, the hairs will bend away in an effort to reduce wave energy damage to the sensitive organelles, which includes a reduction in sensitivity. If the sound levels are loud enough to damage the hairs, the reduction in sensitivity will remain, resulting in a shift in hearing threshold. These threshold shifts can be temporary (temporary threshold shift [TTS]) or permanent (permanent threshold shift [PTS]) (Weilgart 2007) depending on the recovery ability of the stereocilia and connecting hair cells. Over-activation of hair cells can lead to fatigue or damage that remains until cells are repaired or replaced.

Exposure to intense impulsive noises can disrupt and damage hearing mechanisms, leading to a threshold shift. However, these threshold shifts are generally temporary (TTS), as the hair cells have some ability to recover between and after the intermittent sound pulses. Long-term exposure to continuous (non-impulsive) noise, even noise of moderate intensity, can lead to a permanent threshold shift, or PTS. This is because the continuous wave energy does not allow hair cells to recover. If the exposure is long enough, the ability to replace damaged hair cells after the exposure has ceased is also reduced, and the threshold shift becomes permanent.

Anthropogenic sources of underwater impulsive noises that could lead to TTS include seismic surveys, pile driving, and blasting. However, Donlin Gold's barging operation will not produce impulsive noises, so these TTS concerns do not apply. The primary underwater noise associated with the proposed barging operations is the continuous cavitation noise produced from the propeller arrangement on the oceanic tugboats, especially when pushing or towing a loaded barge. Other noise sources include onboard diesel generators and the firing rate of the main engine, but both are subordinate to the blade rate harmonics (Gray and Greeley 1980). These continuous sounds for small ships have been measured at up to 171 decibels (dB) referenced at 1 micropascal in meters (μPa-m) root mean square (rms)) at 1-m source (broadband), and they are emitted at dominant frequencies of less than 5 kHz, and generally less than 1 kHz (Miles *et al*. 1987, Richardson *et al*. 1995, Simmonds *et al*. 2004). Measured cavitation noise from modern cargo ships have peak energies less than 100 Hz (Areveson and Vendittis 2000, McKenna *et al.* 2012), resulting from both the blade rate harmonics and the chaotic collapse of cavities (cavitation), with a rapid drop off of about 6 dB per octave on a constant-bandwith plot (Areveson and Vendittis 2000). Cavitation noise is a potential source for PTS depending on the received noise level (a function of the distance the animal is to the vessel) and duration (dependent on the period animal and vessel are in proximity). Since underwater hearing sensitivity in pinnipeds and odontocetes (*e.g.*, sperm, killer, and beluga whales) is greatest beyond 10 kHz, their effectiveness at hearing cavitation noise is already poor, and the potential for PTS is reduced. The cavitation noise does, however, fall within the effective hearing range of baleen whales (*e.g.*, right, blue, sei, fin, humpback, and gray whales), and PTS could occur if exposure duration was long enough. However, as the tugboat is continually moving at about 9 knots (kt) (17 km/hour [hr]), there is no long-term exposure of a given whale to continuous cavitation noise leading to PTS. Thus, hearing loss in marine mammals is not of concern from the proposed oceanic barging operations. No data currently exists on the physiological effect of anthropogenic noise on marine turtles (Dow Piniak *et al*. 2012), and the exposure duration from the moving vessels is probably far too short to induce PTS. The maximum exposure time to noise exceeding 120 dB would be about 20 minutes (based on a conservative 15 Log r practical spreading model).

5.1.2. Masking

Masking occurs when louder noises interfere with marine mammal vocalizations or their ability to hear natural sounds in the environment (Richardson *et al*. 1995), which limit their ability to communicate, detect prey, or avoid predation or other natural hazards. Masking is of particular concern with baleen whales because low-frequency anthropogenic noises overlap with their communication frequencies. Some baleen whales have adjusted their communication frequencies, intensity, and call rate to limit masking effects. For example, McDonald *et al*. (2009) found that California blue whales have shifted their call frequencies downward by 31% since the 1960s, possibly in an attempt to communicate at frequencies below masking shipping noise frequencies. Melcon *et al*. (2012) found blue whales to increase their call rates in the presence of shipping noise, while Watkins (1986) found fin whales to reduce their calling rate in response to boat noise. Both killer whales (Holt *et al*. 2009) and beluga whales (Scheifele *et al*. 2005) were found to increase the amplitude of their calls (known as the Lombard effect) in response to loud vessel noise levels.

Donlin Gold's planned barging will have some limited, additive effect to the overall anthropogenic noise budget. Donlin Gold plans 12 cargo barging round-trips (24 transits) annually from Seattle to Bethel. These transits represent 0.2% of the nearly 11,000 annual large commercial and passenger ship, tanker, and barging transits occurring within Puget Sound and the Strait of Juan de Fuca (WDOE 2014), and 0.5% of the 4,500 commercial vessels that annually pass through Unimak Pass (TRB 2008). The extent of the existing budget of shipping noise in Puget Sound was further demonstrated by Bassett *et al*. (2012), who found that nearly four commercial vessels of over 300 gross tons passed daily through the narrow Admiralty Inlet, and for over 90% of the time, at least one vessel was detectible by hydrophones.

While odontocetes in general have poor sensitivity to low frequency sounds, the lower frequency component of discrete calls (frequency range of 1 to 10 kHz) in killer whales overlap the frequency range of propeller cavitation noise (Holt 2008). Based on this overlap, Crystal *et al*. (2011) studied commercial shipping noise in Southern Resident killer whale critical habitat and found that the western and eastern ends of the Strait of Juan de Fuca, Boundary Pass, Haro Strait, and the Strait of Georgia were subject to masking noise levels (at least masking of the lower frequency components of the calls) over 90% of the time. Considering noise levels as a function of vessel speed, Crystal *et al*. (2011) concluded that masking level noises could be eliminated completely by reducing commercial vessel speeds to 10 kt (18.5 km/hr).

Most auditory studies on pinnipeds to date indicate that pinnipeds can hear underwater sound signals (such as higher frequency calls) in noisy (low frequency) environments, a possible adaption to the noisy nearshore environment (due to wind, waves, and biologics) they inhabit (Southall *et al*. 2000). Southall *et al*. (2000) found northern elephant seals, harbor seals, and California sea lions lack specializations for detecting low-frequency tonal sounds in noise, but rather were more specialized for hearing broadband noises associated with schooling prey.

The cavitation noise associated with barging overlaps the effective hearing range of adult sea turtles (Ketten and Bartol 2005), possibly leading to masking effects. However, because sea turtles are not known to vocalize underwater, do not feed on prey that vocalize, and as adults are not particularly susceptible to predation, masking is probably of much less concern as compared to marine mammals. There is no quantitative information demonstrating masking effects in marine turtles.

The extent of masking associated with Donlin Gold's barging program is a function of the duration a barge is within hearing proximity of a marine mammal, and the additive noise from Donlin Gold's barging to overall shipping traffic. Masking is not a concern to killer whales at least if, as Crystal *et al*. (2011) have suggested, masking effects are eliminated at speeds less than 10 kt (18.5 km/hr). Whether this would apply also to other odontocetes is unknown. Further, odontocetes compensate for masking effects from vessel noise by increasing call intensity (Lombard effect), although the fitness implications of doing so is unknown. Given the ability for pinnipeds to hear well in noisy backgrounds (Southall *et al*. 2000), combined with the short duration of exposure from the moving vessel, masking concerns are not particularly significant for these marine mammals. As mentioned above, there are no known masking issues with marine turtles.

Masking is of greater concern with large baleen whales. Although masking might increase the risk of large baleen whales to killer whale predation, the increased risk is probably slight and minimal given the overall low predation risk. Communication masking is the primary issue, given the rate at which large baleen whales normally communicate. Communication masking is a function of the loss of communication space as a result of noise relative to the available communication space during quiet conditions (Clark *et al*. 2009). The size of communication space for a given species, in turn, is a function of call frequency range and call intensity. Clark *et al*. (2009) studied potential communication space loss from vessel traffic for singing fin and humpback whales and calling North Atlantic right whales. They found that for the source band (18-28 hertz) in which fin whales sing, source levels from a passing ship (181 dB) were essentially the same as the source level from the whale (180 dB), while for humpback source bands (224-708 hertz), ship source levels (167 dB) were much lower than whale source levels (170 dB). Thus, for both species there was little loss of communication space from the passing ship. However, because right whale call frequencies (71-224 dB) are well within the stronger frequency components from the ship, and right whales calls are relatively soft (160 dB), the source level from the ship (172 dB) is 12 dB higher than from the whale, resulting in nearly full masking of the communication space at the ships closest point. Consequently, the primary noise concern from Donlin Gold's barging is the potential effects on feeding right whales when traversing the Bering Sea right whale critical habitat area.

5.1.3. Chronic Disturbance

Apart from any potential for damaging marine mammal hearing, loud vessels can disrupt normal behaviors of marine mammals either through auditory or visual harassment. Disturbed animals may quit feeding, move away from feeding areas, display overt reactions, or display other behaviors that expend undue energy potentially culminating in lowered fitness. Continued disturbance can lead to chronic stress exposure, further leading to stress-related responses such as immune system suppression, reproductive failure, and slowed growth, and an overall decline in fitness. Chronic stress is exposure to stressors that last for days or longer, and does not apply to a single passing barge. However, disturbance noise from a passing barge (acute stress) can add to the overall stress budget (known as the allostatic load; Romero *et al*. 2009) of an individual marine mammal contributing to general distress and deleterious effects. Additional barging (multiple passes) would, of course, contribute further to the stress load.

In general, baleen whales seem less tolerant of continuous noise (Richardson and Malme 1993) and, for example, often detour around stationary drilling activity when received levels are as low as 119 dB re 1 μPa (rms) (Malme *et al*. 1983, Richardson *et al*. 1985, 1990). These studies are the basis for the threshold for harassment take from continuous noise defined at 120 dB re 1 μPa (rms). Humpback whales have been especially responsive to fast moving vessels (Richardson *et al*. 1995), and often react with aerial behaviors such as breaching or tail/flipper slapping (Jurasz and Jurasz 1979). Humpback whales have also shown a general avoidance reaction at distances from 1.2 to 2.5 mi (2-4 km) of cruise ships and tankers (Baker *et al*. 1982, 1983), although they have displayed no reactions at distances to 0.5 mi (800m) when feeding (Watkins *et al*. 1981, Krieger and Wing 1986), and temporarily disturbed whales often remain in the area despite the presence of vessels (Baker *et al*. 1988, 1992). Odontocetes are probably less sensitive to acoustical disturbance from vessels because of their lower sensitivity to the low frequency noise generated by cavitating propellers. However, the presence of oceanic tug/barges could be disturbing to odontocetes when in close proximity, such as the coincidence of Southern Resident killer whales and barging through the narrow Admiralty Inlet, or beluga whales and barging in confined nearshore summer breeding or feeding habitat in Cook Inlet. Williams *et al*. (2009) found that Southern Resident killer whales travel greater distances in the presence of vessels, presumably to avoid these vessels, leading to increased energy expenditure and reduced fitness.

Most information on the reaction of seals and sea lions to boats relate to disturbance of hauled out animals. None of the proposed barging routes will come within disturbance distance to pinniped haulouts, or cross the 3-nautical-mi buffer surrounding any of the 35 listed rookeries in Alaska. There is little information on the reaction of these pinnipeds to ships while in the water other than some anecdotal information that sea lions are often attracted to boats (Richardson *et al*. 1995).

Marine turtles have poor ability to detect marine vessels (see *Vessel Strikes*); thus, are unlikely to be easily disturbed.

5.1.4. Relevance to Donlin Gold Barging

Donlin Gold’s proposed oceanic barging program will contribute to existing vessel traffic noise along all four barging routes. At times, the tugboat/barge may temporarily disturb marine mammals, especially baleen whales, resulting in acute stress levels and adding to the animal’s overall stress budget. However, the overall effect is probably minimal given that the Donlin Gold’s barging traffic would be well less than 1% of the total vessel traffic in the region, and the normal vessel speed is less than 10 kt (18.5 km/hr), the individual noise source contribution is relatively less than other commercial vessels. Further, the propellers on ocean tugboats are generally recessed under the vessel hull to reduce cavitation and protect the nozzled propellers from damage during a grounding event. As a result, much of the noise emanating from the propellers is blocked (acoustical shadow) by the tugboat’s hull, especially forward of the tug. Moreover, the nozzles themselves reduce cavitation, thereby further reducing noise levels to some degree. Overall, Donlin Gold’s barging program is unlikely to result in chronic disturbance and stress in local marine mammals.

5.2. Vessel Strike

Collisions with marine vessels have been implicated in the deaths of marine mammals (Goldstein *et al*. 1999, Laist *et al*. 2001, Jensen and Silber 2004, Panigada *et al*. 2006, Van Waerebeek *et al*. 2007, Berman-Kowalewski *et al*. 2010) and sea turtles (Hazel 2006). Whale mortality from ship strike is usually a result of blunt force injury from striking the ship bow (blunt trauma), or lethal wounding from propeller cuts (sharp trauma) (Moore *et al*. 2013). Worldwide (Laist *et al*. 2001, Jensen and Silber 2004) and off

Washington (Douglas *et al*. 2008), fin whales are the most common cetacean killed by vessels. This may be a function of a greater population size or higher density in shipping lanes as opposed to a greater biological vulnerability (Douglas *et al*. 2008). Douglas *et al*. (2008) also noted that fin whales were more susceptible to blunt trauma from a bow strike, while gray whales were more likely to be injured by sharp trauma from a propeller strike. Neilson *et al*. (2012) documented 108 ship strikes in Alaska from 1978 to 2011 and found the vast majority to involve humpback whales in Southeast Alaska. All these records indicate that baleen whales are more susceptible to vessel strike than toothed whales. Of the 292 large whale ship strikes recorded by NMFS between 1975 and 2002 (Jensen and Silber 2004), only 17 (6%) involved sperm whales and only one a killer whale. Also, there are no records of lethal vessel strikes involving Cook Inlet beluga whales, although Kaplan *et al*. (2009) did record what appeared to be marks from a small propeller on at least two whales during photo-identification studies conducted from 2005 to 2008.

Vessel speed is the primary factor in the probability of a vessel strike occurring as well as the probability of the strike actually being lethal (Jensen and Silber 2004, Vanderlaan and Taggart 2007). The large whale ship strike database (Jensen and Silber 2004) indicates that the number of vessel strikes by vessels traveling at less than 10 kt (18.5 km/hr) is very low relative to the number of vessels normally traveling at those speeds. Vanderlaan and Taggart (2007) analyzed the ship strike database (Jensen and Silber 2004) and found that the probability of a strike actually being lethal (as opposed to survivable) was also low (<20%) for strikes at speeds less than 8 kt (15 km/hr), but high (>50%) at speeds greater than 12 kt (22 km/hr)). This and additional information was used to develop the 10-kt (18.5-km/hr) restriction now enforced in North Atlantic right whale (NMFS 2008d) habitat off New England. Conn and Silber (2013) estimated that implementation of this vessel speed rule reduced the risk of vessel collisions with right whales by 80% to 90%.

Pinnipeds are far less susceptible to vessel strike, probably because of their visual awareness both above and below water, and their quick maneuverability. Of 6,197 strandings of six species of pinnipeds in central California between 1986 and 1998, only five exhibited vessel strike damage.

Mortality from vessel strikes on sea turtles has been noted as largely unknown but potentially high risk factor. Venizelos (1993) and Lutcavage *et al.* (1997) reported on the frequency of vessel strike injuries to stranded turtles, while Limpus *et al*. (1994) noted impact scars on live turtles. Hazel (2006) reported that between 1990 and 2002, an average of 52 sea turtles, mostly green turtles, were killed off the Queensland east coast of Australia due to vessel strike. Sea turtles are especially vulnerable to vessel strike because they spend much of their time at the ocean surface, and have poor ability to detect oncoming vessels (Hazel 2006, Hazel *et al*. 2007). Although sea turtles can detect vessel noise (Ketten and Bartol 2005, Bartol and Ketten 2006), Hazel (2006) and Hazel *et al*. (2007) found that sea turtles rarely respond to approaching noise, especially if they are subsurface and lack visual clues. Effective flee responses occurred largely in response to vessels traveling at less than 6 kt (11 km/hr), while these turtles rarely fled from vessels traveling at speeds greater than 10 kt (18.5 km/hr). Hazel (2006) also reported that in cooler waters, sea turtles spent a proportionally greater time at the surface where, of course, vulnerability to strike is greater.

5.2.1. Relevance to Donlin Gold Barging

Vessel strikes are most likely to occur where large whale concentration areas overlap with shipping traffic. Neilson *et al*. (2012) identified six collision hotspots in Southeast Alaska based on overlap of shipping traffic and humpback whale use. One of the higher risk hotspots extends from Icy Strait to Cross Sound, and overlaps with over 60 mi (97 km) of the Pacific Inshore route. Saracco *et al*. (2013) observed over 150 humpback whales annually using the Glacier Bay/Icy Strait area since 2005. There are other locations along the Pacific Inshore barging route that also coincide with large whale concentrations. Brueggeman *et al*. (1987, 1988) and Zerbini *et al*. (2006) found feeding concentrations of humpback whales near the Barren Islands, south of the Alaskan Peninsula, especially near the Shumagin Islands, and at Unimak Pass. These same researchers found fin whale concentrations inside Kodiak Island through Shelikof Strait, and along the coastal waters nearshore of the Alaska Peninsula.

The Pacific Offshore route intersects fewer known concentration areas used by large whales. However, Douglas *et al* (2008) identified the Strait of Juan de Fuca as an area of high whale collision risk based on high shipping traffic and concentrated whale use (humpback and fin whales primarily) offshore of Vancouver Island, and the route passes through Unimak Pass, where not only humpback whales concentrate, but the pass is also used by other whales entering the Bering Sea, including fin and right whales. The barging route between Dutch Harbor and Bethel passes through a humpback whale feeding area off Unalaska and Umnak islands identified by Zerbini *et al*. (2006) and both Bering routes pass through right whale critical habitat.

Oceanic tugboats and barges offer very little risk of collision to marine mammals (and sea turtles). First, oceanic barges travel at less than 10 kt (18.5 km/hr), the threshold above which vessel collision is of greatest concern. Further, many of the tugboats used in the towing operations will have their propellers recessed into the vessel hull to prevent bottom-strike in shallow waters and inside protective nozzles. These configurations reduce or eliminate the risk of sharp trauma from contact with the moving propeller blades. The remaining risk, albeit low, is from a potential collision with the bow of a towing (pulling) vessel passing through marine mammal or sea turtle concentration areas. However, ocean tugs are also designed to push up against other vessels and do not generally have sharp, bulbous bows. They may push aside a marine animal rather than strike it with full blunt force, depending on strike angle (Silber *et al.* 2010).

Based on available data (Vanderlaan and Taggart 2007, Neilson *et al.* 2012), oceanic barging poses little risk to other large whales (sei whales, blue whales, sperm whales) because the animals occur in low numbers or densities along the proposed barging routes during the seasons of barging. The barging also poses low risk to killer whales and pinnipeds, as both appear maneuverable and aware enough to easily avoid vessel contact (Lawson and Lesage 2013). Collision risk from barging is also low for North Pacific right whales, fin whales, humpback whales, and Cook Inlet beluga whales, but not nonexistent. The proposed cargo and construction barging routes will pass through designated critical habitat for North Pacific right whales and Cook Inlet beluga whales. Any mortality for these extremely small populations poses a population level risk. As mentioned above, the proposed barging routes also pass through feeding areas of concentrated use by fin and humpback whales. However, Allen *et al.* (2014) estimated that the annual ship strike serious injury/mortality rate for humpback whales in Alaska waters is 1.8 whales. Similarly, Allen *et al.* (2104) estimated the annual mortality rate for Alaskan fin whales at 0.4 whales per year. The collision risk is further lowered given the low (<10 kt [<18.5 km/hr]) vessel speed of the tow operation, especially when compared to faster (>20 kt [37 km/hr]) cargo ships moving to and from Alaska. Neilson *et al.* (2012) reported on 89 cases of ship collisions with marine mammals in Alaska where the vessel type was known. None of the involved vessels were a barge.

5.3. Accidental Spill

A barge related spill would be a large spill involving the rupture of a vessel or transported fuel tank, usually as a result of a collision, sinking, fire, or running aground. Oil effects to marine mammals that could result include skin contact with the oil, ingestion of oil, respiratory distress from hydrocarbon vapors, contaminated food sources, fouled baleen, and displacement from feeding areas (Geraci 1990). Actual impacts would depend on the extent and duration of contact, and the characteristics (age) of the oil. Most likely, the effects of oil would be irritation to the respiratory membranes and absorption of hydrocarbons into the bloodstream (Geraci 1990). If a marine mammal was present in the immediate area of fresh oil, it is possible that it could inhale enough vapors to affect its health. Inhalation of petroleum vapors can cause pneumonia in humans and animals due to large amounts of foreign material (vapors) entering the lungs (Lipscomb *et al*. 1994). Contaminated food sources, an inability to sieve krill due to oil-fouling of baleen, and displacement from feeding areas also may occur as a result of an oil spill. Long-term ingestion of pollutants, including oil residues, could affect reproductive success, but data is lacking to determine how oil may fit into this scheme for marine mammals. Oil can reduce the thermal effects of hair on sea lions resulting in death if significantly oiled, especially for pups. However, following the Exxon *Valdez* oil spill, Loughlin (1994) found no evidence of oil toxicity damage to Steller sea lions stranded or live-sampled, and the ultra-low sulfur diesel (ULSD) fuel that Donlin Gold would be transporting quickly evaporates and dissipates relative to heavier oils (NRC 2014).

Oil exposure effects to sea turtles include burning of mucous membranes around the mouth; inflammation of the skin, gastrointestinal system, and respiratory system; organ damage; suppression of the immune system; and reproductive failure. The number of sea turtle strandings in the Gulf of Mexico spiked in the years following the 2010 Deepwater Horizon disaster, although direct cause of death of these turtles is still under investigation.

Major oil spills have occurred in recent decades from vessels initially following routes similar to the Pacific routes proposed by Donlin Gold. Between 1981 and 2005, at least 26 oils spills of greater than 1,000 gallons occurred in the Aleutians, mostly from fishing vessels (16), although two large spills were from tank barges (TRB 2008). The four largest were:

- The Tank Barge 283 ran aground in 1988 on the Shumagin Islands releasing over 2,000,000 gallons of diesel fuel.
- The M/V *Selendang Ayu* lost power and ran aground on the north shore of Unalaska Island in 2004, eventually breaking up and resulting in 336,000 gallons of heavy fuel oil spilled.
- The M/V *Kuroshima* dragged anchor in Dutch Harbor during a severe storm in 1997, resulting in the loss of 40,000 gallons of heavy fuel oil.
- T/B *Foss 256* was offloading fuel oil cargo at Amchitka Island in 1989 when severe weather pushed the barge over rocks. Several fuel tanks were penetrated spilling 84,000 gallons of diesel fuel.

Further, the remoteness of the barging routes may make it difficult for a quick oil spill response. The longer the oil remains in the marine environment the harder it becomes to collect it. Little of the oil from the aforementioned spills was ever cleaned up.

The risk and effects of a potential chemical spill has not been previously assessed. Information on the chemicals to be transported and the risk of a chemical spill are found in Section 6.1.2.

5.3.1. Relevance to Donlin Gold Barging

Each fuel barge launching from Dutch Harbor has the capacity to carry nearly 3 million U.S. gallons of ultra-low sulfur diesel (ULSD) fuel. Part of the barging route will cross the Great Circle route shipping lanes entering and exiting Unimak Pass. About 6,000 fishing and commercial vessels annually pass through Unimak Pass (TRB 2008), which is nearly double that of all Alaskan ports combined. Given traffic volume, currents (up to 7 kt [13 km/hr]), weather conditions (*e.g.*, fog), mixture of vessel speeds (*e.g.*, slow tug/barges vs. much faster container ships), and remoteness, Unimak Pass has a high risk for collision (Ports and Waterways Safety Assessment 2006), potentially resulting in an oil spill. Unimak Pass traffic also poses a collision risk for Donlin Gold barges coming from Seattle, although the potential oil spill volume is limited to what fuel remains in the tugboat tanks. Unimak Pass and the Pacific Inshore route are also lined with rocky hazards, which could result in a grounding due to engine failure or other accidental reasons. Groundings in remote and rocky Alaska often result in oil release.

However, all the major oil spills mentioned in the previous section occurred in association with winter storms, and Donlin Gold barging would not occur during winter months due to sea and river ice. Also, in Alaska, operations relative to marine fuel transport and transfer are regulated by both Federal and State agencies, more specifically, the U.S. Coast Guard (USCG), U.S. Environmental Protection Agency (EPA), and the State of Alaska Department of Environmental Conservation (ADEC). The USCG requires Vessel Response Plans (VRP) that comply with 33 CFR 155 subparts D, F, G, and I.

The fuel barges from Dutch Harbor would be double-hulled, specifically designed to reduce the risk of oil release in the event of a collision. Based on worldwide oil spills analyzed between 1991 and 2003, of 53 accidents with double-hulled tankers, only four resulted in an oil spill, totaling 115,000 U.S. gallons (DeCola 2009). This compares to 105 accidents involving single-hulled tankers (without segregated ballast tanks), where 14 involved spills totaling over 70 million U.S. gallons.

Most of the proposed cargo barging coming out of Seattle will follow the Pacific Inland route. Although many portions of this route are narrow and pose a collision hazard, traffic north of Vancouver is relatively light, thereby lessening collision risk. However, Rosario Strait, running along the eastern side of the San Juan Islands, has been recognized as a waterway in Puget Sound with a high collision risk and major oil spill potential based on vessel exposure time (Van Dorp and Merrick 2014). This is because the narrow channel is shared by oil tankers moving to and from Vancouver ports and oil refineries near Anacortes and Bellingham, coupled with treacherous tidal currents. In the event of a collision, maximum oil release from the tug/barge would be limited to the diesel fuel remaining in the tugboat fuel tanks (which are largely recessed to prevent rupture in the event of a grounding). However, if the accident involves colliding with the oil tanker, the oil release could be magnitudes higher, with commensurate consequences to local marbled murrelet populations. The risk is mitigated by the USCG's Vessel Traffic Services program, which monitors all ship traffic within the confined waterways of Puget Sound, the Strait of Juan de Fuca, and Georgia Strait in cooperation with the Canadian Coast Guard under the Cooperative Vessel Traffic Agreement. This program provides real-time information to vessel captains on approaching traffic and travel conditions.

A chemical spill could also occur during a collision or allision event, including during a grounding while traveling up and down the Kuskokwim River. However, the safety measures addressed above regarding reducing oil spill risk, also apply to a chemical spill risk.

5.4. Incidental Spill

Incidental spills are chemicals spills which can be safely controlled at the time of release by shipboard personnel, do not have the potential to become an emergency within a short time, and are of limited quantity, exposure and potential toxicity. Incidental spills also include normal vessel operational discharges such as release of ballast or bilge water that might contain oils or oily detergents from deck washdown operations. They also include accidental releases of small volumes of hydraulic fluids, motor fuels and oils, and other fluids used in normal ship operation, usually as a result of overfilling tanks. Incidental spills can also occur during vessel and transportation tank fueling at Dutch Harbor docks. The accumulation of a number of small spills can lead to impaired marine waters.

5.4.1. Relevance to Donlin Gold Barging

Incidental spills associated with Donlin Gold's barging program are most likely to occur in port (Seattle, Dutch Harbor, Bethel, Anchorage, or Beluga) during fuel and supply transfer, with the greatest risk during fuel barge filling operations at Dutch Harbor and offloading at Bethel. However, given Bethel is located nearly 70 mi (113 km) upstream from the mouth of Kuskokwim River, incidentally spilled fuel will most likely have dispersed long before reaching marine waters used by listed marine mammals.

Facility Response Plans (FRP) are also required by the USCG for transfer of fuel from marine tank vessels to shore-based fuel storage facilities. These FRP requirements are described in 33 CFR 154 subparts F, H, and I and typically regulate fuel transfer operations from the vessel to the marine header at the fuel storage terminal.

The EPA requires both Spill Prevention Control and Countermeasure (SPCC) Plans and FRPs for shore-based fuel storage facilities where over-water fuel transfers occur. These requirements are described in 40 CFR part 112.

ADEC regulates marine tank vessels in state waters, transfer of fuel across the water, and fuel storage and distribution through the requirements of 18 AAC 75. All of these various regulations stem from and are integrated through the Oil Pollution Act of 1990 (OPA 90), promulgated following the Exxon Valdez oil spill which occurred in 1989. They focus on spill prevention by specifying construction standards, use of established procedures (for example fuel transfer procedures), conduct of regular equipment inspections, and personnel training. They also focus on spill response by requiring pre-staged spill response equipment, pre-identification of sensitive areas, personnel training, and regular spill drills. Agency inspections are also important elements of assuring spill response prevention, preparation and readiness. In Alaska, both dock and vessel operations relative to fuel transfer are required to develop Oil Discharge Prevention and Contingency Plan (ODPCPs) as regulated under 18 AAC 75. The plans must include a response action plan in the event of a spill, a prevention plan detailing the best management practices that will be implemented to avoid a spill occurrence, and a review of the best available technology for detecting and recovering oil discharges.

Spill response crisis management systems that conform to the National Incident Management System (NIMS) are also required. This assures seamless integration with state and federal response resources in the event that they are needed.

Both Dutch and Iliuliuk harbors were listed as impaired waters for Settleable Solids, Dissolved Oxygen, and Petroleum Hydrocarbons. In 1995 a Total Maximum Discharge Load was established related to waste discharges from Seafood Processors. Further sampling from 2006 to 2008 indicated that while the water column met State of Alaska Water Quality Standards (WQS), sediments did not. Focus since that time has been on Best Management Practices to minimize further petroleum hydrocarbon and other contaminant inputs.

North Pacific Fuel is regulated through an Alaska Pollutant Discharge Elimination System Multi-sector General Permit (MSGP) number AKR05DB55. These MSGP's are designed to assure that all discharges from regulated facilities meet WQS. Sediment contamination is thought to be a result of historic spills, perhaps occurring as long ago as World War II when more than a million gallons of fuel was released during a Japanese bombing attack, as well as stormwater discharges from upland contaminated sites. Small spills at or near docks continue to contribute to impairment with an average of 1,000 gallons of petroleum products spilled annually into the waters or onto adjacent shorelines of Dutch and Iliuliuk harbors (ADEC 2010).

ADEC (2010) has evaluated the three bulk fuel storage and transfer facilities (Delta Western and two North Pacific Fuel facilities) and written "The three facilities appear to have implemented BMPs [Best Management Practices], developed the appropriate plans for spill scenarios, and properly managed their operations. There is no indication that these facilities are chronic sources of petroleum pollutants for the study area". But they did recognize that the almost 20 million gallons of fuel stored does pose a potential high risk to water quality.

Given the required fuel best management practices and containment capabilities located at Dutch Harbor, it is unlikely that an incidental fuel spill would result in the escape and travel of enough fuel to result in any consequential exposure to a listed marine mammal under NMFS jurisdiction. Incidental spills are not addressed further as potential risk.

5.5. Effects to Prey

For the listed species addressed in this assessment, nearly all feed on small schooling fish, shrimp, squid, and zooplankton. The exceptions are the sea turtles, which feed largely on jellyfish and tunicates. All these prey species could become contaminated from spills leading to bioaccumulation or biomagnification of toxins in listed species (Eisler 1987, Almeda *et al.* 2013a, b). Plankton appears to be particularly sensitive to oil (ITOPF 2014a); however, small schooling fish generally do not live long enough to bioaccumulate large amounts of toxins, and fish are able to metabolize polycyclic aromatic hydrocarbons, the oil contaminant of greatest concern (Eisler 1987). Further, because of its high viscosity, fuel oil is less readily incorporated into live tissue and, thus, is less bioavailable than, for example, crude oil (ITOPF 2014b).

Barging activity can directly affect plankton, fish eggs, fish larvae, and small fish through hull shear, entrainment through the propulsion system, exposure to turbulence in the propeller wash, and wake stranding (Odom *et al.* 1992). However, studies have found it difficult to detect barge-related mortality (Holland 1986, Odom *et al.* 1992), and have found fish larvae to be relatively resilient. Wake stranding, the depositing of fish onto shore by vessel-induced waves, is a function of wave amplitude, which further is a result of vessel size, vessel draft, vessel speed, and distance of vessel from shore (Bauersfeld 1977). Ackerman (2002) studied salmonid stranding in the lower Columbia River and found that shallow-draft tugs pulling barges produced much smaller wake amplitudes (average of 0.52 feet [ft] [0.15 meters [m]]) than larger, deep-draft ships (1.7 ft [0.52 m]), and all but one of the observed salmonid strandings were associated with deep-draft ships. The distances to shore during this study ranged from 780 to 1,630 ft (238-497m), or much closer to shore than the proposed travel routes for the Donlin barging. Thus, the Donlin barges probably do not produce large enough wakes and are not close enough to shore to cause any significant wave mortality stranding of prey fish.

Acoustical effects to prey resources are also limited. Christian *et al.* (2004) studied seismic energy impacts on male snow crabs (*Chionoecetes* sp.) and found no significant increases in physiological stress due to exposure. No acoustical impact studies have been conducted to date on Alaskan fish species, but studies have been conducted on Atlantic cod (*Gadus morhua*) and sardine (*Clupea* sp.). Davis *et al.* (1998) cited various studies and found no effects to Atlantic cod eggs, larvae, and fry when received levels were 222 dB. Effects found were to larval fish within about 16.4 ft (5m), and from air guns with volumes between 3,000 and 4,000 cubic inches. Similarly, effects to sardines were greatest on eggs and 2-day larvae, but these effects were also confined to 16.4 ft (5m). Further, Greenlaw *et al.* (1988) found no evidence of gross histological damage to eggs and larvae of northern anchovy (*Engraulis mordax*) exposed to seismic air guns, and concluded that noticeable effects would result only from multiple, close exposures. All these studies involved impulsive noise of very high energy, much higher than the continuous noise associated with tug propeller cavitation. Given the little response of potential prey to impulsive noise, the noise associated with barging activity is not likely to affect benthic or fish prey.

6. DIRECT EFFECTS

6.1. Insignificant and Discountable Effects

The Endangered Species Consultation Handbook describes insignificant effects as those that are so small that they "should never reach the scale where take occurs", and discountable effects "are those extremely unlikely to occur". A Donlin Gold barging accident resulting in an oil or chemical spill represents a low likelihood, high impact event. The impacts of a spill could range from negligible to high depending on the nature and amount of material spilled, environmental factors, and response. Neither spill event, should it occur, could be considered insignificant if listed species were present in the affected area. However, if the risk of such a spill were low enough, the effects would be discountable. The following sections address the oil and chemical spill risk associated with Donlin Gold's proposed barging.

6.1.1. Risk of Oil Spill

The maximum fuel capacity for Ocean Class tugboats is 6,000 barrels (bbl), while the fuel barges will transport up to 69,000 bbl. Annually, these fuel barges will make about 14 round trips between Dutch Harbor and Bethel during mine operation, plus an additional three to six trips over the three to four construction years. All barge fuel tanks will be double-hulled.

Accident and fuel spill risks from fuel transportation have been analyzed. Papanikolaou *et al.* (2006), analyzed hull design relative to tanker accidents worldwide. For the period of 1991-2003, when double-hulled tankers became common, the study found that 53 accidents with double-hulled tankers produced 4 spills over a period of 2,133 shipyears. The total quantity of spills was 2,707 bbl or 1.3 bbl per shipyear. In contrast, during 2,137 single-hull shipyears (over the same 13-year period) 105 accidents occurred, resulting in 14 spills. The total amount spilled – 1,654,761 bbl – was much higher with 774 bbl spilled per shipyear. A few very large spills accounted for most of the oil loss (Papanikolaou *et al.* 2006). Although this analysis was limited to tankers, the fact remains that double-hulled tank use has dramatically reduced both the number and volume of spills worldwide. In addition, navigation and vessel control technology has advanced further reducing spill risk.

More specific to Donlin Gold's project, Anderson *et al.* (2012) analyzed the occurrence rate for offshore oil spills, including barge oil spill rates in all US waters (marine and inland). Between 1991 and 2008, there were 34 barge oil spills of 1,000-10,000 bbl, 3 of 10,000-25,000 bbl, and 1 greater than 25,000 bbl. This equated to 2.1 spills greater than 1,000 bbl per year nationwide. During that period 1.6 to 1.8 billion barrels (Bbbl) of oil were transported annually. Between the periods of 1974 and 1993, and 1994 and 2008, the barge spill rates declined dramatically. The spill rate for spills greater than 1,000 bbl dropped from 3.37 (1974-1993) to 1.20 (1994-2008) spills per Bbbl transported, while for spills greater than 10,000 bbl, the rate dropped from 0.81 to 0.16 spills per Bbbl transported. They attributed the declines to the transition to double-hulled tanks.

The information above was used to estimate the risk of an oil spill associated with the Donlin Gold project. The Project includes transport from Dutch Harbor to Bethel a maximum of 69,000 bbl per trip or about 1 million bbl per year. Given a spill rate of 1.20 spills per Bbbl (spills greater than 1,000 bbl) based on Anderson et al (2012), the annual spill risk for the Donlin Gold project 1 million bbl yearly transports is 0.0012. Over 35 years, the greater than 1,000 bbl spill risk is 0.042 (for 35 million bbl transported). For a spill over 10,000 bbl, the annual risk is 0.00016, and over 35 years is 0.0056. The PDEIS stated that the probability of spills of these sizes occurring as very low (defined as a probability of approaching zero).

The spill risks identified above, (0.0012 for a spill of greater than 1000 bbl and 0.0056 for a spill of greater than 10,000 bbl over 35 years) are low enough to be defined as discountable.

6.1.2. Risk of Chemical Spill

The risk of a chemical spill during barging that would result in a spill, coupled with a release of a volume that could adversely affect a listed species or critical habitat, is extremely low. The pathway for a chemical spill to affect a listed species or critical habitat would start with a barging accident that affected the particular chemical container. That container would need to be breached and the contents come into contact with the environment. Finally, there would need to be receptors (listed species) present to be exposed the contaminated water. The details regarding spill risk and controls can be found in Section 3.24 of the Donlin Gold Project PDEIS.

A chemical spill into water would likely be the result of a major or catastrophic barge incident. Saricks and Tompkins (1999) estimated the risk of a barge accident (allisions, collisions, breakaways, fires, explosions, groundings, structural failures, flooding, capsizing, and sinking) that occurred within 100 mi (160 km) of the coastline. The risk is 5.29 x10^{-7} accident per 500 short ton (st)/km. Over the life of the mine operations (27.5 years) this translates to 0.00013[1] accidents. It is important note that a barge accident, may or may not result in a chemical spill to water. Therefore, the risk of chemical spill would be less than 0.00013 over the life of the mine. Similarly, the PDEIS stated that the risk of a cyanide spill would be very low (defined as a probability approaching zero).

This is an extremely low accident risk and, based on precedent, is discountable for the purposes of the ESA.

6.2. North Pacific Right Whale

6.2.1. Disturbance

Donlin Gold's barging operations, including both supply and fuel barges, will traverse Bering Sea designated critical habitat for the North Pacific right whale during the period these whales would actively be using the area. Because the eastern Pacific population of this species is critically low (approximately 30 animals), any undue effect on the population can have great consequences on long-term survival. A primary concern is the effects barging noise might have on displacement of feeding right whales and/or masking communication.

Noise risk was evaluated by assuming noise effects occur when noise levels from the barge/tug exceed 120 dB re 1 µPa (rms). Using a conservative practical spreading model (15 Log r) and assuming a source level of 171 dB re 1 µPa (rms), the radius to the 120 dB isopleth would be 1.56 mi (2.5 km). Considering both sides of the vessel, the tug/barge would ensonify a swath 3.12 mi (5 km) wide over the 179-mi (288-km) portion of the route that transits right whale critical habitat, or ensonify 558 mi^2 (1,445 km^2) of critical habitat, which represents only 1.56% of the 35,780-mi^2 (92,670-km^2) Bering Sea critical habitat. In using another metric, if it is assumed that 30 right whales inhabit the Bering Sea critical habitat during the barging

[1] (Accident Rate) x $\frac{Total\ distance\ traveled\ with\ Cargo\ (km)}{Total\ Cargo\ \ (st)}$ therefore $5.29\ \cdot 10^{-7} \cdot \frac{500\ st}{1\ km} \cdot \frac{1973277.6\ km}{3981547\ st} = 0.00013$

period, the whale density would be 1 animal for approximately 1,193 mi^2 (3,089 square km), or 0.47 animals per the area (barge route) ensonified. Further, given a 9-kt (17-km/hr) vessel travel speed, the maximum exposure time for a stationary whale on the vessel path would only be 21 minutes, or far too short a period to elicit PTS concerns. If the barging route does intersect North Pacific right whale critical habitat, the determination is ***May Affect, Not Likely to Adversely Affect.***

6.2.2. Vessel Strike

Given the slow speed of the barge/tug (less than 10 kt [18.5 km/hr]), and the very low density of right whales within the designated critical habitat, vessel strike is a discountable concern. The determination is ***May Affect, Not Likely to Adversely Affect.***

6.2.3. Accidental Spill

Barges from both Seattle and Dutch Harbor would follow or cross the Great Circle Route shipping lane as it enters and exits Unimak Pass. The number of vessels that annually pass through Unimak Pass is double that calling on all other ports in Alaska with approximately 4,500 large vessel transits annually (TRB 2008). These vessels are bottle-necked by a 4-mi (6.4-km) safety fairway within the 10-mi (16-km) wide pass. Coupled with frequent severe weather conditions, especially fog, Unimak Pass is one of the highest large vessel collision risk locations in the world. Further, entrances to Unimak Pass are lined with rocky hazards, winds can be exceedingly strong, and USCG rescue services are 500 mi (804 km) away (Kodiak), greatly increasing the risk of oil-release in a grounding due to power loss, tow line separation, collision, or grounding. Moreover, oil spill response capabilities near Unimak Pass are minimal.

Oceanographic studies indicate that both Alaska Stream and Alaska Coastal Current (ACC) waters pass north through Unimak Pass, with the ACC becoming the Bering Coastal Current running along the north side of the Alaska Peninsula into Bristol Bay. Drifter trajectory studies (TRB 2008) confirm that significant current drift from Unimak Pass moves on to the Bering Shelf and into Bristol Bay. Consequently, it is likely that a significant oil spill in or near Unimak Pass could reach the Bering Sea right whale critical habitat.

However, the four large spills in the Unimak area since 1988 occurred during winter months and severe weather conditions, and none involved collisions with other vessels. The Donlin Gold fuel barging program will reduce oil spill risk because 1) they cannot operate in winter months when weather conditions are extreme, 2) they will be using barges with double-hull tanks to reduce the potential for tank rupture, and 3) by using updated radar equipment to avoid other vessels traveling in the proximity. While the risk of an oil spill associated with Donlin Gold’s barging operations is highest while traveling in the vicinity of Unimak Pass, the overall risk is discountable based on the risk assessment and safety measures mentioned in Section 6.1.1. The determination for accidental oil spill is ***May Affect, Not Likely to Adversely Affect.***

6.2.4. Incidental Spill

North Pacific right whales do not inhabit harbor waters where the risk of an incidental spill during fuel or cargo transfer is more likely to occur. Also, safety measures in place would prevent spills from reaching habitat used by this species. Thus, the determination for incidental spill is ***No Effect***.

6.2.5. Effects on Critical Habitat

Both the offshore and inshore barging routes completely avoid Gulf of Alaska critical habitat area. However, the Bering Sea route would intersect the Bering Sea critical habitat area, but the proposed barging activity would have little or no effect on the habitat. The one event that could significantly impact the critical habitat would be an oil spill event involving a fuel barge. However, the risk assessment in Section 6.1.1 has shown the risk of an oil spill is discountable. In addition, there is little potential for a major collision or allision in the center Bristol Bay because of a lack of rocks, shorelines, and boat traffic. Further, because diesel fuel quickly evaporates and disperses (compared to crude oil), the spill risk in the critical habitat area is even lower. The determination for North Pacific right whale critical habitat is ***May Affect, Not Likely to Adversely Affect***.

6.3. Sei Whale

6.3.1. Disturbance

The current use of the proposed barging routes by sei whales is virtually unknown. Rice (1998) indicated that sei whales seasonally occur in the Gulf of Alaska and deeper waters of the Bering Sea, but sightings are so few Allen and Angliss (2014) did not include this species in the Alaska stock assessment report. It is possible that Pacific barging operations might encounter this species while crossing pelagic waters of the Gulf of Alaska, but expected sightings are so few that barging noise effects would be essentially discountable. The determination for disturbance to sei whales is ***May Affect, Not Likely to Adversely Affect***.

6.3.2. Vessel Strike

Given the slow speed of the barge/tug (less than 10 kt [18.5 km/hr]), and the very low density of sei whales along the proposed barging routes, vessel strike concerns are discountable. The determination for vessel strike is ***May Affect, Not Likely to Adversely Affect.***

6.3.3. Accidental Spill

Sei whales are pelagic whales that do not inhabit passes or near shorelines where spill risks from collisions or allisions are highest. Based on rarity of the species in the action area, the risk is discountable. The determination for accidental spill risk is ***May Affect, Not Likely to Adversely Affect***.

6.3.4. Incidental Spill

Sei whales do not occur in harbor waters where the risk of an incidental spill during fuel or cargo transfer is more likely to occur. Also, safety measures in place would prevent spills from reaching habitat used by this species. Thus, the determination for incidental spill is ***No Effect***.

6.3.5. Effects on Critical Habitat

There is no designated critical habitat for sei whales.

6.4. Blue Whale

6.4.1. Disturbance

Three blues whales were sighted in the Gulf of Alaska in 2004 (Calambokidis *et al*. 2009) confirming that a few animals from the California summering population are again venturing to Alaskan waters. The Pacific Inshore barge route, as it crosses the northern end of the Gulf of Alaska, straddles the locations of these sightings. However, these are the only sightings in Alaskan waters over the last four decades, and represent a very few animals over a vast region. Thus, barging noise effects risk is discountable given the low density of blue whales along the travel routes. The determination for disturbance of blue whales is ***May Affect, Not Likely to Adversely Affect***.

6.4.2. Vessel Strike

As with disturbance, the likelihood of barge activities even encountering blue whales is very remote, and coupled with the less than 10-kt (18.5 km/hr) vessel speed of the barges, the risk of vessel strike is discountable. The determination for vessel strike risk for blue whales is ***May Affect, Not Likely to Adversely Affect***.

6.4.3. Accidental Spill

Oil spills from collisions or allisions are also a minimal risk given the whale's pelagic distribution. The determination is ***May Affect, Not Likely to Adversely Affect*** for accidental spills based on rarity of the species in the action area.

6.4.4. Incidental Spill

Blue whales are largely pelagic and are not found in harbors where incidental spills are most likely. The determination is ***No Effect***.

6.4.5. Effects on Critical Habitat

There is no designated critical habitat for blue whales.

6.5. Fin Whale

6.5.1. Disturbance

Both the Pacific Inshore and Offshore barging routes will pass through areas where fin whales concentrate during summer. Thus, there is the potential for propeller noise and vessel presence to disturb fin whales. However, any disturbance would be limited to exposure to low levels of continuous noise that would last for only a few minutes (~20 minutes), and is probably insignificant at a population level. The determination is ***May Affect, Not Likely to Adversely Affect*** for disturbance.

6.5.2. Vessel Strike

Fin whales are also the most common large whale struck by vessels worldwide, and they can be found in waters along the proposed barging routes. However, because the barge will be traveling at speeds less than

10 kt (18.5 km/hr), the risk of ship strike is low to the point of discountable. Thus, the determination is ***May Affect, Not Likely to Adversely Affect*** for vessel strike.

6.5.3. Accidental Spill

The barging routes include narrow travel channels weaving around hazardous rocks and other obstacles where collision and allision risks are greatest, some of which occur in the vicinity of fin whale concentration areas. However, as shown in Section 6.1.1, the safety measures to be implemented will reduce the risk of an oil spill to discountable levels resulting in a determination of ***May Affect, Not Likely to Adversely Affect*** for accidental spills.

6.5.4. Incidental Spill

Fin whales are not found in harbors where incidental spills are most likely. The determination is ***No Effect***.

6.5.5. Effects on Critical Habitat

There is no designated critical habitat for fin whales.

6.6. Humpback Whale

6.6.1. Disturbance

The Pacific Inshore and Offshore barging route in particular will pass through humpback whale concentration areas. Thus, there is the potential for propeller noise and vessel presence to disturb humpback whales. However, any disturbance would be limited to exposure to low levels of continuous noise that would last for only a few minutes (~20 minutes), and is probably insignificant at a population level. The determination is ***May Affect, Not Likely to Adversely Affect*** for disturbance.

6.6.2. Vessel Strike

Similar to fin whales mentioned above, the Pacific Inshore and Offshore barging routes will pass through areas where humpback whales concentrate during the summer, including areas in Southeast Alaska already identified as vessel strike hotspots (Nielson *et al*. 2012) and other areas of potentially high vessel strike risk such as the Strait of Juan de Fuca and Unimak Pass. It is also important to note that humpback whales comprise the vast majority of vessel strike records in Alaska (Nielson *et al*. 2012). However, because of the low (<10 kt [18.6 km/hr) vessel speed, the risk of a vessel strike is essentially discountable and, therefore, resulting in a ***May Affect, Not Likely to Adversely Affect*** determination.

6.6.3. Accidental Spill

The Pacific Inshore route follows narrow channels lined with rocky hazards posing both collision and allision risks that might lead to an oil spill. However, as shown in Section 6.1.1, the risk of an oil spill is discountable resulting in a determination of ***May Affect, Not Likely to Adversely Affect*** for accidental spills.

6.6.4. Incidental Spill

Humpback whales are not found in harbors where incidental spills are most likely. The determination is **No Effect**.

6.6.5. Effects on Critical Habitat

There is no designated critical habitat for humpback whales.

6.7. Killer Whale – Southern Resident Stock

6.7.1. Disturbance

Noise harassment from tug/barges traveling through Puget Sound, the Strait of Juan de Fuca, and the Strait of Georgia could potentially occur to populations of Southern Resident killer whales given their propensity to travel through these areas as well. However, killer whales are well accustomed to vessel activity in these areas (including from whale watching and fishing boats), and Crystal *et al*. (2011) concluded that masking from vessel noise in this area is virtually eliminated by reducing vessel speed to the less than 10-kt (18.5-km/hr)speed the barges will travel. The determination for disturbance is ***May Affect, Not Likely to Adversely Affect*** as at some point the vessels are likely the encounter killer whales, but the vessel presence is unlikely to elicit a significant behavioral response.

6.7.2. Vessel Strike

Of the 292 large whale ship strikes recorded by NMFS between 1975 and 2002 (Jensen and Silber 2004), only one was a killer whale. In general, toothed whales are far less susceptible to vessel strike than large baleen whales, probably because of their greater maneuverability. This, coupled with the less than 10-kt (18.5-km/hr) barge speed, reduces the vessel strike risk from Donlin Gold's barging activity to discountable, resulting in a determination of ***May Affect, Not Likely to Adversely Affect***.

6.7.3. Accidental Spill

Collision/allision risk, resulting in a fuel spill, occurs where barging travels through constrictions such as Admiralty Inlet and Rosario Strait, but this risk is discountable (see Section 6.1.1) given that the tug/barges will follow the designated Traffic Separation Scheme (TSS) shipping lanes, and maintain communication with the USCG's Vessel Traffic System which has full radar coverage of the TTS, in addition to onboard radar systems. The determination for accidental spill from a supply barge accident is ***May Affect, Not Likely to Adversely Affect***.

6.7.4. Incidental Spill

Although Southern Resident killer whales inhabit the inland waters of Washington and British Columbia, they are unlikely to occur near docking facilities associated with cargo and fuel transfer to the barges where incidental spills are most likely to occur. The determination is ***No Effect*** for incidental spill.

6.7.5. Effects on Critical Habitat

Barging activity through Puget Sound, the Strait of Juan de Fuca, and the Strait of Georgia will pass through Southern Resident killer whale critical habitat. These waters are already plied by numerous commercial ships, barges, fishing boats, and pleasure craft. Donlin Gold's additive contribution to the traffic – less than 0.5% – would be insignificant. In addition, the likelihood of a barging accident leading to a spill is discountable (see Sections 6.1.1 and 6.1.2). Thus Donlin Gold's barging program ***May Affect, Not Likely to Adversely Affect*** Southern Resident killer whale critical habitat.

6.8. Beluga Whale – Cook Inlet Stock

6.8.1. Disturbance

The Cook Inlet construction barging route will run from Anchorage to near the town of Beluga, with about 20 round trips (40 transits) in a single year. Nearly the entire route will run through Cook Inlet Beluga Designated Critical Habitat Area 1, at a time of year when beluga whales actively use this summer habitat. The proposed barge landing location at Beluga is situated only 7.3 mi (11.7 km) south of the mouth of the Beluga River, a known summer concentration area. Beluga whales occurring within approximately 1.5 mi (2.4 km) of active barges are likely to be exposed to noise exceeding 120 dB (Level B harassment criterion), and for possibly extended periods if bow thrusters are used to maintain barge position on beach. NMFS limits industrial activities within 10 mi (16 km) of the mouth of the Beluga River between April 15 and October 15; however, concerns have focused on impulsive noise activities such as seismic exploration. The normal maritime traffic noise the proposed barging activity would produce would exceed 120 dB within 10 mi (16 km) of the Beluga River, but it would fall below background noise levels before reaching the areas where belugas actually concentrate. Thus, the determination is ***May Affect, Not Likely to Adversely Affect*** for disturbance.

6.8.2. Vessel Strike

Vessel strike risk from the slow moving (less than 10 kt [18.5 km/hr]) tug/barge is low. As mentioned earlier, there are no records of lethal vessel strikes involving Cook Inlet beluga whales, (although Kaplan *et al*. (2009) did record what appeared to be marks from a small propeller on at least two whales during photo-identification studies conducted from 2005 to 2008). Beluga whales, a maneuverable toothed whale, may be somewhat susceptible to strike by a fast moving small fishing boat as the known strike marks suggest, but they are not likely to be struck by a tug/barge moving at less than 10 kt (18.5 km/hr). Therefore, the determination is ***May Affect, Not Likely to Adversely Affect*** for vessel strike.

6.8.3. Accidental Spill

There are few collision or allision hazards along the short, 40-mi (64-km) route to elevate spill risks. The primary cargo will be pipe, and the fuel in the tug's fuel tanks represent the only spill hazard. The only pathway for a spill would be the extremely unlikely event of a collision with another vessel. As mentioned in Section 6.1.1, the risk of such a spill is discountable leading to a spill determination of ***May Affect, Not Likely to Adversely Affect***.

6.8.4. Incidental Spill

The Port of Anchorage loading docks lay at the mouth of Knik Arm, an important seasonal feeding area for beluga whales. Whales moving in and out of the Arm are often observed in the vicinity of the docks and, therefore, could be exposed to contaminants resulting from an incidental petroleum spill at the docks. The greatest spill risk would likely be during tug fueling operations. It is unclear at this time where the tug operators would fuel, but it likely to occur either at the loading docks or their home berth near Anchorage. However, given the low likelihood of a fuel spill, the safety and response measures that would be in place, the small size of any spill that would occur, and the very short period beluga whales would be expected to remain within the vicinity of these docks, the potential effects to beluga whales is insignificant. Thus, the determination is ***May Affect, Not Likely to Adversely Affect*** for incidental spill.

6.8.5. Effects on Critical Habitat

Nearly all the Cook Inlet barging activity would occur within beluga whale critical habitat area 1, the region where beluga whales concentrate during the summer to feed on migrating fish, breed, and molt, although barging activity would not occur over the Susitna Delta where most of this whale activity is found. (A portion of the Cook Inlet route also crosses beluga whale critical habitat area 2 where belugas forage during the winter months, but not so much during the barging season.) The proposed barging activity could affect critical habitat via noise pollution or contamination from a fuel spill. However, underwater noise emanating from the tug would not extend to Susitna Delta (and mouth of the Beluga River) where whales actually concentrate, and the risk of a fuel spill is discountable (see Section 6.1.1). The project determination is ***May Affect, Not Likely to Adversely Affect*** for Cook Inlet beluga whale critical habitat.

6.9. Sperm Whale

6.9.1. Disturbance

Sperm whales are pelagic in distribution and are not expected to be encountered along any barging route except possibly along the southern half of Pacific Offshore route, but their densities are expected to be very low. Barge noise effects are also expected to be minimal given, again, their low likelihood of encounter, plus the short exposure time (~20 minutes) by the passing barge. Finally, sperm whales are high-frequency odontocetes and probably do not fully perceive low-frequency vessel noise. The determination for disturbance of sperm whales is ***May Affect, Not Likely to Adversely Affect***.

6.9.2. Vessel Strike

Ship strike risk is also minimal given the likely low density of sperm whales along the travel route, coupled with the less than 10-kt (18.5-km/hr) vessel speed of the barges. The determination for vessel strike of sperm whales is ***May Affect, Not Likely to Adversely Affect***.

6.9.3. Accidental Spill

Oil or chemical spill risk from collisions or allisions is discountable based on the risk analysis in Section 6.1.1, especially given the whale's pelagic distribution. The determination is ***May Affect, Not Likely to Adversely Affect*** for accidental spill risk to sperm whales.

6.9.4. Incidental Spill

Sperm whales occur in pelagic waters and are not found in harbor waters where incidental spills are most likely to occur (such as during cargo and fuel transfer). The determination is ***No Effect*** for incidental spills.

6.9.5. Effects on Critical Habitat

There is no designated critical habitat for sperm whales.

6.10. Steller Sea Lion – Western and Eastern DPSs

6.10.1. Disturbance

Because the effective hearing of Steller sea lions is largely above the major noise frequencies of cavitating propellers and they appear adapted to hear important sounds in noisy backgrounds, Steller sea lions are likely not susceptible to continuous noise disturbance in open water. Also, there are no PTS concerns because Steller sea lions remain underwater for only short periods of time and, thus, there are no long duration exposures to underwater noise. Thus, the determination for disturbance of Steller sea lions from barging activity is ***May Affect, Not Likely to Adversely Affect***.

6.10.2. Vessel Strike

Sea lions are highly maneuverable and, thus, not very susceptible to vessel strike, especially with a vessel traveling at less than 10 kt (18.5 km/hr). From 1978 to 2014, there have been only four confirmed sea lion mortalities in Alaska resulting from ship collisions (NMFS, unpublished data). Collision with a tug/barge is highly unlikely to the point of discountable. The determination is ***May Affect, Not Likely to Adversely Affect*** for vessel strike.

6.10.3. Accidental Spill

Collectively, both Pacific barging routes pass within a few miles of over 40 Steller sea lion rookeries or haulouts. The rocky areas these sea lions inhabit also pose navigation hazards, and the risk of a collision with another vessel while traversing a narrow passage or grounding on rocky reefs remains possible. These risks apply to both the Western and Eastern DPSs. However, the risk of an accidental oil or chemical spill is low to the point of discountable (see Sections 6.1.1 and 6.1.2). Thus, the determinations is ***May Affect, Not Likely to Adversely Affect*** for accidental spill risk.

6.10.4. Incidental Spill

Incidental spills are most likely to occur during cargo and fuel transfer at loading and unloading docks. There are no Steller sea lion haulouts in the vicinity of the Seattle docks (Jeffries *et al*. 2000), and they essentially are not found near Anchorage, Beluga, or Bethel. They are commonly found around the docks at Dutch Harbor where they seek handouts and feed on fish waste during harvest offloading. At this time, they could be exposed to a petroleum spill if it occurred during fuel transfer. However, the Spill Prevention Control and Countermeasure Plans and FRP's required by EPA and USCG for shore-based fuel storage facilities where over-water fuel transfers occur, would require that measures be implemented to prevent and control any fuel spill that might occur. Therefore, with these measures in place, the determination for incidental spill is ***May Affect, Not Likely to Adversely Affect***.

6.10.5. Effects on Critical Habitat

The proposed barging activity could affect Steller sea lion critical habitat via noise pollution or contamination from a fuel spill. However, Steller sea lions are accustomed to vessel traffic and accidental spill risks are discountable. The Donlin Gold barging project ***May Affect, Not Likely to Adversely Affect*** Steller sea lion critical habitat.

6.11. Leatherback Turtle

6.11.1. Disturbance

The barge activity could disturb leatherback turtles during close encounters along the Pacific Offshore route, especially since the hearing range of sea turtles greatly overlaps the noise frequencies of cavitating tug propellers. However, these large sea turtles are uncommon along the proposed barging routes. In the unlikely event they were encountered, noise exposure would be limited to about 20 minutes. Sea turtles do not appear to respond to underwater noise levels until they exceed 175 dB re 1 μPa (rms) (O'Hara and Wilcox 1990, Moein-Bartol *et al.* 1995, McCauley *et al.* 2000), or greater than the 171 dB re 1 μPa (rms) source level for small ships such as tugs pulling barges (Richardson *et al*. 1995). Even then the response behaviors could not be confirmed as agitation (McCauley *et al.* 2000). Finally, while Ketten and Bartol (2005) confirmed that sea turtles can detect vessel noise, Hazel (2006) and Hazel *et al*. (2007) found that sea turtles rarely respond to vessel noise. The determination is ***May Affect, Not Likely to Adversely Affect*** for noise disturbance to leatherback turtles.

6.11.2. Vessel Strike

Because sea turtles rarely respond to vessel noise, they can be susceptible to vessel strike, especially if they are just below the surface and lack visual clues (Hazel 2006, Hazel *et al*. 2007). Sea turtles appear to be more effective at safely fleeing from slow moving vessels (<6 kt [11 km/hr]) than from fast moving ones (>10 kt [18.5 km/hr]), possibly because it is more difficult for these large turtles to quickly perceive the risk in time to respond (Hazel 2006, Hazel *et al*. 2007). Donlin Gold's proposed barging along the Pacific Offshore route may pose a strike risk to sea turtles that feed there in the summer. However, this risk is extremely low because of the slow barge speed, and because of the low leatherback sea turtle population. Low densities of sea turtles expected to occur north of their Pacific Northwest critical habitat area. The determination for vessel strike is ***May Affect, Not Likely to Adversely Affect***.

6.11.3. Accidental Spill

Oil or chemical spill risk from collisions or allisions is discountable based on the risk analysis in Sections 6.1.1 and 6.1.2, especially given the leatherback turtle's pelagic distribution. The determination is ***May Affect, Not Likely to Adversely Affect*** for accidental spill risk to leatherback sea turtles.

6.11.4. Incidental Spill

Leatherback turtles are generally pelagic in nature and are not found in inland Puget Sound harbor waters where incidental spills are most likely to occur. The determination is ***No Effect*** for incidental spill.

6.11.5. Effects on Critical Habitat

Both the Pacific Inshore and Offshore barging routes avoid the leatherback turtle critical habitat in Washington offshore waters. The determination is ***No Effect***.

7. INDIRECT EFFECTS

The Donlin Gold barging program will be implemented to supply fuel and cargo to a planned gold mine located more than 250 mi (402 km) up the Kuskokwim River. Other than the barging activity addressed in this assessment, there are no direct or ancillary mine features that involve marine waters, other than additional fuel transport to Dutch Harbor to supply Donlin Gold's fuel vendors located at Dutch Harbor. This fuel transport is not specifically addressed as it is presently unknown from where this additional fuel will be purchased, and is a part of normal business operation with Dutch Harbor fuel vendors. However, fuel purchase by Donlin Gold represents additional sales that would not have occurred but for the project, and will require additional fuel transport to and storage at Dutch Harbor. No other indirect effects have been identified.

8. CUMULATIVE EFFECTS ANALYSIS

For purposes of consultation under the ESA, cumulative effects are future state or private activities not involving federal activities that are reasonably certain to occur within the action area of an action subject to consultation. Relative to barging, the action areas are the barging routes between Seattle and Bethel, Dutch Harbor and Bethel, and Anchorage and Beluga (there are no listed species occurring along the Kuskokwim River barging route between Bethel and the mine port near Crooked Creek). Actions similar to Donlin Gold's barging program are the existing shipping traffic along these routes that also contribute to noise, strike, and spill hazard. Donlin Gold's operation will add to the shipping traffic in Washington, British Columbia, and Alaska, but by no more than 0.5% over existing traffic. However, with the expected increase in shipping traffic volume through the Strait of Juan de Fuca and Unimak Pass over the estimated 35 year barging program, especially with increase in tanker ship traffic carrying Canadian crude oil to China over the Great Circle route, Donlin Gold cargo barges will be traversing more crowded shipping lanes leading to an increase in collision risk. Further, Unimak Pass is a conduit to oil & gas exploration and increased cargo traffic to and through the Alaskan Arctic. Donlin Gold barging can expect to be part of the expected increase in Alaskan shipping traffic congestion. Several projects are planned for Cook Inlet that would also contribute noise and strike risk to local marine mammals including the Alaska LNG pipeline project, the Chuitna coal terminal project, and several oil & gas seismic and drilling programs planned in both upper and lower Cook Inlet. All these projects will have associated mitigation and monitoring plans designed to limit impacts to Cook Inlet marine mammals.

9. DETERMINATION OF EFFECTS SUMMARY

A determination of effects for each species for the five evaluated risk categories is found in Table 3.

TABLE 3: DETERMINATION OF EFFECTS FOR EACH ESA LISTED SPECIES POTENTIALLY OCCURRING ALONG DONLIN GOLD'S PROPOSED BARGING ROUTES

Species	Noise	Vessel Strike	Accidental Oil Spill	Incidental Spill	Critical Habitat	Overall
North Pacific Right Whale	NLAA	NLAA	NLAA	NE	NLAA	NLAA
Sei Whale	NLAA	NLAA	NLAA	NE	N/A	NLAA
Blue Whale	NLAA	NLAA	NLAA	NE	N/A	NLAA
Fin Whale	NLAA	NLAA	NLAA	NE	N/A	NLAA
Humpback Whale	NLAA	NLAA	NLAA	NE	N/A	NLAA
Killer Whale – Southern Resident	NLAA	NLAA	NLAA	NE	NLAA	NLAA
Beluga Whale – Cook Inlet	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Sperm Whale	NLAA	NLAA	NLAA	NE	N/A	NLAA
Steller Sea Lion – Western DPS	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Steller Sea Lion – Eastern DPS	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Leatherback Turtle	NLAA	NLAA	NLAA	NE	NE	NLAA

NE = No Effect
NLAA = Not Likely to Adversely Affect
N/A = Not Applicable

10.LITERATURE CITED

Ackerman, N.K. 2002. Effects of vessel wake stranding of juvenile salmonids in the lower Columbia River, 2002 – a pilot study. S.P. Cramer & Associates report to USACOE, Portland. 47 pp.

Agler, B.A., R.L. Schooley, S.E. Frohock, S.K. Katona, and I.E. Seipt. 1993. Reproduction of photographically identified fin whales, *Balaenoptera physalus*, from the Gulf of Maine. J. Mamm. 74:577-587.

Alaska Department of Environmental Conservation (ADEC). 2010. Total Maximum Daily Loads (TMDLs) for Petroleum Hydrocarbons in the Waters of Dutch Harbor and Iliuliuk Harbor in Unalaska, Alaska. Alaska Department of Environmental Conservation, 555 Cordova Street, Anchorage, Alaska 99501. 75 pp.

Allen, B.M. and R.P. Angliss. 2014. Alaska marine mammal stock assessments, 2013. NOAA Technical Memorandum NMFS- AFSC-277, Alaska Fisheries Science Center, Seattle, WA. 282 pp.

Allen, B.M., V.T. Helker, and L.A. Jemison. 2014. Human-caused injury and mortality of NMFS-managed Alaska marine mammals stocks, 2007-2011. NOAA Technical Memorandum NMFS- AFSC-274, Alaska Fisheries Science Center, Seattle, WA. 84 pp.

Almeda R, Wambaugh Z, Chai C, Wang Z, Liu Z, Buskey EJ. 2013a. Effects of Crude Oil Exposure on Bioaccumulation of Polycyclic Aromatic Hydrocarbons and Survival of Adult and Larval Stages of Gelatinous Zooplankton. PLoS ONE 8(10): e74476. doi:10.1371/journal.pone.0074476

Almeda R, Wambaugh Z, Wang Z, Hyatt C, Liu Z, Buskey EJ. 2013b. Interactions between Zooplankton and Crude Oil: Toxic Effects and Bioaccumulation of Polycyclic Aromatic Hydrocarbons. PLoS ONE 8(6): e67212. doi:10.1371/journal.pone.0067212

Anderson, C.M., M. Mayes, and R. LaBelle. 2012. Update of occurrence rates for offshore oil spills. OCS Report BOEM 2012-069. 76 pp.

Arveson, P.T. and D.J. Vendittis. 2000. Radiated noise characteristics of a modern cargo ship. Journal of the Acoustical Society of America 107:118–129.

Baird, R.W. 2001. Status of killer whales, *Orcinus orca*, in Canada. Canadian Field-Naturalist 115:676-701.

Baker, C.S., L.M. Herman, B.G. Bays, and W.F. Stifel. 1982. The impact of vessel traffic on the behavior of humpback whales in southeast Alaska Contract 81-ABE00114, NMFS, National Marine Mammal Laboratory, Seattle, WA. 78 pp.

Baker, C.S., L.M. Herman, B.G. Bays, and G.B. Bauer. 1983. The impact of vessel traffic on the behavior of humpback whales in Southeast Alaska: 1982 season. Report submitted to the National Marine Mammal Laboratory, NMFS, Seattle, WA. May 17, 1983. 3 pp.

Baker, S. 1988. Behavioural responses of humpback whales to vessels in Glacier Bay. Proceedings of the Workshop to Review and Evaluate Whale Watching Programs and Management Needs, November 1988. Center for Marine Conservation, Washington DC. 16 pp.

Baker, C.S., J.M. Straley, and A. Perry. 1992. Population characteristics of individually identified humpback whales in southeastern Alaska: Summer and fall 1986. Fishery Bulletin, U.S. 90:429-437.

Balcomb, K. C., and D. E. Claridge. 2001. Mass whale mortality: U.S. Navy exercises cause strandings. Bahamian Journal of Science 8:1-12.

Bane, G. 1992. First report of a loggerhead sea turtle from Alaska. Mar. Turtle Newsl. 58:1-2.

Barlow, J., R.W. Baird, J.E. Heyning, K. Wynne, A.M. Manville, II, L.F. Lowry, D. Hanan, J. Sease, and V.N. Burkanov. 1994. A review of cetacean and pinniped mortality in coastal fisheries along the west coast of the USA and Canada and the east coast of the Russian Federation. Rep. int. Whal. Commn (Special Issue 15):405-425.

Barlow, J. 1997. Preliminary estimates of cetacean abundance off California, Oregon, and Washington based on a 1996 ship survey and comparisons of passing and closing modes. Admin. Rept. LJ-97-11.

Barlow, J. 2010. Cetacean abundance in the California Current estimated from a 2008 ship-based line-transect survey. NOAA Technical Memorandum NMFS-SWFSC-456. National Oceanic and Atmospheric Administration.

Barlow, J., J. Calambokidis, C. S. Baker, A. M. Burdin, P. J. Clapham, J. K. B. Ford, C. M. Gabriele, R. LeDuc, D. K. Mattila, T. J. I. Quinn, L. Rojas-Bracho, J. M. Straley, B. L. Taylor, J. Urban-Ramirez, P. Wade, D. Weller, B. H. Witteveen, and M. Yamaguchi. 2011. Humpback whale abundance in the North Pacific estimated by photographic capture-recapture with bias correction from simulation studies. Marine Mammal Science 27:793-818.

Bartol, S.M., J.A. Musick, and M.L. Lenhardt. 1999. Auditory evoked potentials of the loggerhead sea turtle (*Caretta caretta*). Copeia. 1999:836-840.

Bartol S.M. and D.R. Ketten. 2006. Turtle and tuna hearing. Pg. 98-105 In: Swimmer, Y. and R. Brill, eds. Sea turtle and pelagic fish sensory biology: Developing techniques to reduce sea turtle bycatch in longline fisheries. NOAA Tech. Memo. NMFS-PIFSC-7.

Bassett C., B. Polagye, M. Holt, and J. Thomson. 2012. Vessel noise budget for Admiralty Inlet, Puget Sound, Washington (USA). J. Acoust. Soc. Am. 132:3706-3719.

Bauersfeld, K. 1977. Effects of peaking (stranding) of Columbia River Dams on juvenile anadromous fishes below The Dalles Dam, 1974 and 1975. State of Washington Department of Fisheries report to the U.S. Army Corps of Engineers, Contract DACW 57-74-C-0094, 32 pp.

Benson, S. R., T. Eguchi, D. G. Foley, K. A. Forney, H. Bailey, C. Hitipeuw, B. P. Samber, R. F. Tapilatu, V. Rei, P. Ramohia, J. Pita, and P. H. Dutton. 2011. Large-scale movements and high-use areas of western Pacific leatherback turtles, *Dermochelys coriacea*. Ecosphere 2(7):art84.

Berman-Kowalewski, M., Gulland, F. M. D., Wilkin, S., Calambokidis, J., Mate, B., Cordaro, J., Rotstein, D., Leger, J. S., Collins, P., Fahy, K., and Dover, S. 2010. Association between blue whale (*Balaenoptera musculus*) mortality and ship strikes along the California coast. Aquatic Mammals 36:59-66.

Berzin, A.A., and A.A. Rovnin. 1966. Distribution and migration of whales in the northeastern part of the Pacific Ocean, Bering and Chukchi Seas. Izv. Tikhookean. Nauchno-issled. Inst. Rybn. Khoz. Okeanogr. (TINRO) 58:179-207. {In Russian] (Transl. by U.S. Dep. Inter., Bur. Commer. Fish., Seattle, Washington, 1966, pp. 103-106. In: Panin, K.I. (ed.) Soviet research on marine mammals of the Far East).

Best, P.B., P.A.S. Canham, and N. MacLeod. 1984. Patterns of Reproduction in Sperm Whales, *Physeter macrocepahlus*. In Rep. Int. Whal. Comm Special Issue 6.

Bowlby, C. E., G. A. Green, and M. L. Bonnel. 1994. Observations of leatherback turtles offshore of Washington and Oregon. Northwestern Naturalist 75:33-35.

Bowles, A.E., M. Smultea, B. Wursig, D.P. DeMaster, D. Palka. 1994. Abundance of marine mammals exposed to transmissions from the Heard Island Feasibility Test. Journal of the Acoustical Society of America 96:2469-2482.

Bradford, A.L., Wade, P.R., Burdin, A.M., Ivashchenko, Y.V., Tsidulko, G.A,, VanBlaricom, G.R., Brownell, R.L., Jr. and Weller, D.W. 2003. Survival estimates of western North Pacific gray whales (*Eschrichtius robustus*). Paper SC/54/BRG14 presented to the International Whaling Commission Scientific Committee (unpublished). 34 pp.

Brownell, R.L., P.J. Clapham, T. Miyashita, and T. Kasuya. 2001. Conservation status of North Pacific right whales. Journal of Cetacean Research and Management. (Special Issue 2):269-286.

Brueggeman, J.J., G.A. Green, R.A. Grotefendt, D.G. Chapman. 1987. Aerial surveys of endangered cetaceans and other marine mammals in the northwestern Gulf of Alaska and southeastern Bering Sea. Outer Continental Shelf Environmental Assessment program. Final Reports of Principal Investigators OCS/MMS-89/0026. 61:1-24.

Brueggeman, J.J., Green, G.A., Tressler, R.W., Chapman, D.G., 1988. Shipboard surveys of endangered cetaceans in the northwestern Gulf of Alaska, US Department of Commerce, NOAA, OCSEAP Final Report 61, pg 125–188.

Burns, J.J. and Seaman, G.A. 1986. Investigations of belukha whales in coastal waters of western and northern Alaska. Part II. Biology and ecology. Final report submitted to NOAA Outer Continental Shelf Environmental Assessment Program. 129 pp.

Calambokidis, J., E.A. Falcone, , T.J. Quinn, A.M. Burdin, P.J. Clapham, J.K.B. Ford, C.M. Gabriele, R. LeDuc, D. Mattila, L. Rojas-Bracho, J.M. Straley, B.L. Taylor, J. Urbán R., D. Weller, B.H. Witteveen, M. Yamaguchi, A. Bendlin, D. Camacho, K. Flynn , A. Havron, J. Huggins, N. Maloney, J. Barlow, and P.R. Wade. 2008. SPLASH: Structure of Populations, Levels of Abundance and Status of Humpback Whales in the North Pacific. Final report for Contract AB133F-03-RP-00078 prepared by Cascadia Research for U.S. Dept of Commerce. May 2008.

Calambokidis J., J. Barlow, J.K.B. Ford, T.E. Chandler, and A.B. Douglas. 2009. Insights into the population structure of blue whales in the Eastern North Pacific from recent sightings and photographic identification. Marine Mammal Science 25:816-832.

Calambokidis, J., E. Falcone, A. Douglas, L. Schlender, and J. Huggins. 2010. Photographic identification of humpback and blue whales off the U.S. West Coast: results and updated abundance estimates from 2008 field season. Final Report for Contract AB133F08SE2786 from Southwest Fisheries Science Center. 18pp.

Calkins, D.G. 1983. Susitna hydroelectric project phase II annual report: big game studies. Vol. IX, belukha whale. ADFG, Anchorage, Alaska. 15 pp.

Calkins DG, Goodwin EA. 1988. Investigation of the declining sea lion population in the Gulf of Alaska. Alaska Department of Fish and Game, 333 Raspberry Road, Anchorage, AK 99518. 76 pp.

Calkins D.G. 1989. Status of belukha whales in Cook Inlet. In: Jarvela LE, Thorsteinson LK (eds) Gulf of Alaska, Cook Inlet, and North Aleutian Basin information update meeting. Anchorage, AK, Feb. 7 – 8, 1989, USDOC, NOAA, OCSEAP, Anchorage, AK, pp. 109–112.

Calkins, D.G. 1998. Prey of Steller sea lions in the Bering Sea. Biosphere Conservation 1:33-44.

Cameron, M.F., J. L. Bengston, P.L. Boveng, J.K. Jansen, B.P. Kelly, S.P. Dahle, E.A. Logerwell, J.E. Overland, C.L. Sabine, G.T. Waring, and J.M. Wilder. 2010. Status review of the bearded seal (*Erignathus barbatus*). U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-211, 246 pp.

Carretta, J. V., K. A. Forney, E. Oleson, K. Martien, M. M. Muto, M. S. Lowry, J. Barlow, J. Baker, B. Hanson, D. Lynch, L. Carswell, R. L. B. Jr., J. Robbins, D. K. Mattila, K. Ralls and M. C. Hill. 2012. U.S. Pacific Marine Mammal Stock Assessments: 2011, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Science Center.

Carretta, J. V., E. Oleson, D. W. Weller, A. R. Lang, K. A. Forney, J. Baker, Brad H., K. Martien, M. M. Muto, M. S. Lowry, J. Barlow, D. Lynch, L. Carswell, R. L. Brownell, Jr., D. K. Mattila, and M. C. Hill. 2013. U.S. Pacific marine mammal stock assessments: 2012. NOAA Technical Memorandum NMFS-SWFSC-504, Southwest Fisheries Science Center, San Diego, California.

Chapman, D.G. 1976. Estimates of stocks (original, current, MSY level and MSY) (in thousands) as revised at Scientific Committee meeting 1975. Rep. int. Whal. Commn 26:44-47.

Christensen, I., T. Haug, and N. Øien. 1992. A review of feeding and reproduction in large baleen whales (Mysticeti) and sperm whales *Physeter macrocephalus* in Norwegian and adjacent waters. Fauna norvegica Series A 13:39-48.

Christian, J.R., A. Mathieu, and R.A. Buchanan. 2004. Chronic effects of seismic energy on snow crab (*Chionoecetes opilio*). Environmental Studies Research Funds Report No. 158, Calgary, AB.

Clapham, P. J., S. Leatherwood, I. Szczepaniak, and R. L. Brownell, Jr. 1997. Catches of humpback and other whales from shore stations at Moss Landing and Trinidad, California, 1919-1926. Mar. Mamm. Sci. 13:368-394.

Clapham, P., C. Good, S. Quinn, R.R. Reeves, J.E. Scarff, and R.L. Brownell, Jr. 2004. Distribution of North Pacific right whales (*Eubalaena japonica*) as shown by 19th and 20th century whaling catch and sighting records. J. Cetacean Res. Manage. 6:1-6.

Clark C.W., W.T. Ellison, B.L. Southall, L. Hatch, S.M. van Parijs, A. Frankel, and D. Ponikaris. 2009. Acoustic masking in marine ecosystems: intuitions, analyses and implication. Mar Ecol Prog Ser. 395:201–222

Conn, P.B. and G.K. Silber. 2013. Vessel speed restrictions reduce risk of collision-related mortality for North Atlantic right whales. Ecosphere 4: Article 43.

Croll, D.A., R. Kudela, and B.R. Tershy. 2007. Ecosystem Impact of the Decline of Large Whales in the North Pacific. Chapter 16 in J. Estes, D.P. DeMaster, D. Doak, T. Williams, and R. Brownell, (Eds.). Whales, Whaling, and Ocean Ecosystems. UC Press. Pg. 200-212.

Crystal D., K. Moseley, C. Paterson, R. Ryvola, and S. Wang. 2011. Commercial Shipping Noise Impacts on the Critical Habitat of the Southern Resident Killer Whale (*Orcinus orca*). UBC Environmental Sciences.

Dahlheim, M.E. and J.E. Heyning. 1999. Killer whale Orcinus orca (Linnaeus, 1758). Pages 281-322 in S. Ridgway and R. Harrison, editors. Handbook of marine mammals. Academic Press, San Diego, California.

Davis, R.A., D. Thomson, and C.I. Malme. 1998. Environmental assessment of seismic exploration of the Scotian Shelf. Unpublished Report by LGL Ltd., environmental research associates, King City, ON and Charles I. Malme, Engineering and Science Services, Hingham, MA for Mobil Oil Canada Properties Ltd, Shell Canada Ltd., and Imperial Oil Ltd.

DeCola, E. 2009. A Review of Double Hull Tanker Oil Spill Prevention Considerations, Report to Prince William Sound RCAC. Nuka Research & Planning Group, LLC. P.O. Box 175 Seldovia, Alaska 99663.

DeMaster, D. P. 2011. Results of Steller sea lion surveys in Alaska, June-July 2011. Memorandum to J. Balsiger, K. Brix, L. Rotterman, and D. Seagars, December 5, 2011. Available AFSC, National Marine Mammal Laboratory, NOAA, NMFS 7600 Sand Point Way NE, Seattle WA 98115.

DFO. 2008. Recovery strategy for the northern and southern resident killer whales (*Orcinus orca*) in Canada. Species at Risk Act Recovery Strategy Series. Fisheries & Oceans Canada, Ottawa. ix + 81pp.

Dolphin, William F. 1987. Observations of Humpback Whale, *Megaptera novaeangliae*, Killer Whale, *Orcinus orca*, Interactions in Alaska: Comparison with Terrestrial Perdator-Prey Relationships. Canadian Field-Naturalist 101:70-75.

Douglas, A.B., J. Calambokidis, S. Raverty, S.J. Jeffries, D.M. Lambourn, and S.A. Norman. 2008. Incidence of ship strikes of large whales in Washington State. Journal of the Marine Biological Association of the United Kingdom 88:1121-1132.

Dow Piniak, W.E., D.A. Mann, S.A. Eckert, and C.A. Harms. 2012. Amphibious Hearing in Sea Turtles. In: Popper, A.N. and A. Hawkins, eds. The Effects of Noise on Aquatic Life. Advances in Experimental Medicine and Biology Vol. 730. Springer, New York, NY. Pp: 83-87.

Eisler, R. 1987. Polycyclic aromatic hydrocarbon hazards to fish, wildlife, and invertebrates: a synoptic review. U.S. Fish and Wildlife Service Biological Report 85(1.11).

Estes, J. A., Tinker, M. T., Williams, T. M., Doak, D. F. 1998. Killer Whale Predation Linking Oceanic and Nearshore Ecosystems. Science 282:473-476

Finneran, J.J., D.A. Carder, C.E. Schlundt, and S.H. Ridgeway. 2005. Temporary threshold shift in bottlenose dolphins (*Tursiops truncates*) exposed to mid-frequency tones. J. Acoust. Soc. Am. 118:2696–2705.

Flinn, R.D., Trites, A.W., Gregr, E.J. and Perry, R.I. 2002. Diets of fin, sei and sperm whales in British Columbia: An analysis of commercial whaling records, 1963-1967. Mar. Mamm. Sci. 18:663-679.

Ford J.K.B., G.M. Ellis, and K.C. Balcomb. 1994. Killer whales. Vancouver, British Columbia: UBC Press.

Ford, J.K.B. 2002. Killer whale Orcinus orca. Pages 669-676 in W. F. Perrin, B. Würsig, and J. G. M. Thewissen, editors. Encyclopedia of marine mammals. Academic Press, San Diego, California.

Ford, J. K. B. and G. M. Ellis. 2006. Selective foraging by fish-eating killer whales *Orcinus orca* in British Columbia. Marine Ecology Progress Series 316:185-199.

Forney, K.A. 2007. Preliminary estimates of cetacean abundance along the U.S. west coast and within four National Marine Sanctuaries during 2005. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-406. 27 pp.

Frost, K. J., and L. F. Lowry. 1981, Foods and trophic relationships of cetaceans in the Bering Sea. In D. W. Hood and J. A. Calder (eds.), The Eastern Bering Sea shelf oceanography and resources, Vol. 2. Univ. Washington Press, Seattle, WA, pp. 825-836.

Gambell, R. 1985. Fin Whale, *Balaenoptera physalus*. In S Ridgway, R Harrison, eds. Handbook of Marine Mammals, Vol. 3, first Edition. San Diego, CA: Academic Press Inc. Pp. 171-192.

Geraci, J.R. 1990. Physiologic and Toxic Effects on Cetaceans. Chapter 6: J.R. Geraci and D.J. St. Aubin (eds.), Sea Mammals and Oil: Confronting the Risks. San Diego, California: Academic Press, Inc., pp. 167-197.

Gray, L.M. and D.S. Greeley. 1980. Source level model for propeller blade rate radiation for the world's merchant fleet. Journal of the Acoustical Society of America 67:516–522.

Greenlaw, C.F., D.V. Holliday, R.E. Pieper, and M.E. Clark. 1988. Effects of airgun energy releases on the northern anchovy. Journal of the Acoustical Society of America 84:S165.

Gregr, E. J., L. Nichol, J. K. B. Ford, G. Ellis, and A. W. Trites. 2000. Migration and population structure of northeastern Pacific whales off coastal British Columbia: An analysis of commercial whaling records from 1908-1967. Marine Mammal Science 16:699-727.

Goddard, P. D., and D. J. Rugh. 1998. A group of right whales seen in the Bering Sea in July 1996. Marine Mammal Science. 14:344-349.

Goldstein, T., S.P. Johnson, A.V. Phillips, K.D. Hanni, D.A. Fauquier, and F.M.D. Gulland. 1999. Human-related injuries observed in live stranded pinnipeds along the central California coast 1986-1998. Aquatic Mammals 25:43-51.

Good, C., and D. Johnston. 2009. Spatial modeling of optimal North Pacific right whale (*Eubalaena japonica*) calving habitats. North Pacific Research Board Project Final Report 718.

Hanson, B., R.W. Baird, and G. Schorr. 2005. Focal behavioral observations and fish-eating killer whales: improving our understanding of foraging behavior and prey selection. Abstract at the 16th Biennial Conference on the Biology of Marine Mammals, San Diego, California.

Hazel, J. 2006. Vessel-related mortality of sea turtles in Queensland, Australia. Wildlife Research 33:149-154.

Hazel, J., Lawler, I. R., Marsh, H., Robson, S. 2007. Vessel speed increases collision risk for the green turtle *Chelonia mydas*. Endangered Species Research 3:105-113

Hobbs, R. C., K. E. W. Shelden, D. J. Vos, K. T. Goetz, and D. J. Rugh. 2006. Status review and extinction assessment of Cook Inlet belugas (*Delphinapterus leucas*). AFSC Processed Rep. 2006-16. Alaska Fish. Sci. Cent., NOAA, Natl. Mar. Fish. Serv., 7600 Sand Point Way NE, Seattle, WA. 74 pp.

Hobbs, R. C., and K. E. W. Shelden. 2008. Supplemental status review and extinction assessment of Cook Inlet belugas (*Delphinapterus leucas*). AFSC Processed Rep. 2008- 08, 76 p. Alaska Fish. Sci. Cent., NOAA, Natl. Mar. Fish. Serv., 7600 Sand Point Way NE, Seattle WA 98115.

Hobbs, R. C., K. E. W. Shelden, D. J. Rugh, and S. A. Norman. 2008. 2008 status review and extinction risk assessment of Cook Inlet belugas (*Delphinapterus leucas*). AFSC Processed Rep. 2008-02, 116 p. Alaska Fish. Sci. Cent., NOAA, Natl. Mar. Fish. Serv., 7600 Sand Point Way NE, Seattle WA 98115.

Hodge, R.P. and B.L. Wing. 2000. Occurrences of marine turtles in Alaska waters: 1960-1998. Herpetological Review 31(3):148-151.

Holland, L.E. 1986. Effects of barge traffic on distribution and survival of ichthyoplankton and small fishes in the upper Mississippi River. Trans. Am. Fish. Soc. 115:162-165.

Holt, M.M. 2008. Sound exposure and Southern Resident killer whales (*Orcinus orca*): A review of current knowledge and data gaps. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-89, 59 p.

Holt M.M., D.P. Noren, V. Veirs, C. Emmons, S. Veirs. 2009. Speaking up: killer whales (*Orcinus orca*) increase their call amplitude in response to vessel noise. J Acoust Soc Am 125:EL27–EL32.

International Tanker Owners Pollution Federation Limited (ITOPF). 2014a. Effects of Oil Pollution on Fisheries and Mariculture. Technical Information Paper 11. 11 pp. Accessed at http://www.itopf.com/knowledge-resources/documents-guides/document/tip-13-effects-of-oil-pollution-on-the-marine-environment/

International Tanker Owners Pollution Federation Limited (ITOPF). 2014b. Effects of Oil Pollution on the Marine Environment. Technical Information Paper 13. 11 pp. Accessed at http://www.itopf.com/knowledge-resources/documents-guides/document/tip-11-effects-of-oil-pollution-on-fisheries-and-mariculture/

Jeffries, S. J., P. J. Gearin, H. R. Huber, D. L. Saul, and D. A. Pruett. 2000. Atlas of seal and sea lion haulout sites in Washington. Washington Department of Fish and Wildlife, Olympia, Washington.

Jensen, A.S. and G.K. Silber. 2004. Large whale ship strike database. U.S. Department of Commerce, NOAA Technical Memorandum. NMFS-OPR-25.

Johnson, J. H., and A. A. Wolman. 1984. The humpback whale, *Megaptera novaeangliae*. Mar. Fish. Rev. 46:30-37.

Jurasz, C.M., and V.P. Jurasz. 1979. Feeding modes of the humpback whale, *Megaptera novaeangliae*, in southeast Alaska. Scientific Reports of the Whales Research Institute, 31:69-83.

Kaplan, C.C., T.L. McGuire, M.K. Blees, and S.W. Raborn. 2009. Longevity and causes of marks seen on Cook Inlet Beluga Whales. Chapter 1 In: Photo-identification of beluga whales in Upper Cook Inlet, Alaska: Mark analysis, mark-resight estimates, and color analysis from photographs taken in 2008. Report prepared by LGL Alaska Research Associates, Inc., Anchorage, AK, for National Fish and Wildlife Foundation, Chevron, and ConocoPhillips Alaska, Inc. 32 pp.

Katsak D. and R.J. Schusterman. 1998. Low-frequency amphibious hearing in pinnipeds: Methods, measurements, noise, and ecology. J Acoust Soc Am 103:2216-2228.

Kelly B.P., O.H. Badajos, M. Kunnasranta, J.R. Moran, M. Martinez-Bakker, D. Wartzok, and P. Boveng. 2010. Seasonal home ranges and fidelity to breeding sites among ringed seals. Polar Biol 33:1095–1109.

Ketten D.R and S.M. Bartol. 2005. Functional measures of sea turtle hearing: final report to the Office of Naval Research. Woods Hole Oceanographic Institution, Woods Hole, MA.

Kraus, S. D. 1990. Rates and potential causes of mortality in North Atlantic right whales. Marine Mammal Science. 6:278-291.

Kraus, S. D., R. M. Pace III, and T. R. Frasier. 2007. High investment, low return: the strange case of reproduction in *Eubalaena glacialis*. Pages 172-199 in S. D. Kraus, and R. Rolland, editors. The Urban Whale: North Atlantic Right Whales at the Crossroads. Harvard University Press, Cambridge, Massachusetts.

Kreiger, K. and B.L. Wing. 1984. Hydroacoustic surveys and identification of humpback whale forage in Glacier Bay, Stephens Passage, and Frederick Sound, southeastern Alaska, Summer 1983. NOAA Tech. Memo. NMFSINWC-66. 60pp.

Kreiger, K. and Wing, B.L 1986. Hydroacoustic monitoring of prey to determine humpback whale movements. NOAA Tech. Memo. NMFSNWC-98.62 pp.

Lawson, J.W. and Lesage, V. 2013. A draft framework to quantify and cumulate risks of impacts from large development projects for marine mammal populations: A case study using shipping associated with the Mary River Iron Mine project. DFO Can. Sci. Advis. Sec. Res. Doc. 2012/154 iv + 22 p

Laist, D.W., A.R. Knowlton, J.G. Mead, A.S. Collet, M. Podesta. 2001. Collisions between ships and whales. Marine Mammal Science, 17:35-75.

Limpus, C.J., Couper, P.J., Read, M.A., 1994. The green turtle, *Chelonia mydas*, in Queensland: population structure in a warm temperate feeding area. Mem. Queensl. Mus. 35:139–154.

Lipscomb T.K., R.K. Harris, A.H. Rebar, B.E. Bellachey, R.J. Haebler. 1994. Pathology of sea otters. In: Loughlin TR (ed) Marine mammals and the ‘Exxon Valdez’. Academic Press, San Diego, CA, p 265–280.

Loshbaugh, D. 1993. Dead turtle may have set northern record. Homer News, October 28, 1993.

Loughlin T.R. (ed.) 1994. Marine mammals and the 'Exxon Valdez'. Academic Press, San Diego, CA.

Lutcavage, M.E., P. Plotkin, B. Witherington, and P.L. Lutz. 1997. Human impacts on sea turtle survival. In: Lutz, P.L., Musick, J.A. (Eds.), The Biology of Sea Turtles, vol. 1. CRC Press, Boca Raton, Fla, pp. 387–409.

Madsen, P.T., Wahlberg, M., Tougaard, J., Lucke, K. and Tyack, P. (2006). Wind turbine underwater noise and marine mammals: implications of current knowledge and data needs. Mar. Ecol. Progr. Ser. 309, 279-295.

Malme, C.I., P.R. Miles, C.W. Clark, P. Tyack, and J.E. Bird. 1983. Investigations of the potential effects of underwater noise from petroleum industry activities on migrating gray whale behavior (BBN Report No. 5366; NTIS PB86-174174). Report from Bolt Beranek and Newman Inc. for U.S. Minerals Management Service, Anchorage, AK.

Malme, C.I., P.R. Miles, C.W. Clark, P. Tyack, and J.E. Bird. 1984. Investigations of the potential effects of underwater noise from petroleum industry activities on migrating gray whale behavior/Phase II: January 1984 migration. BBN Rep. 586. Rep. from Bolt, Beranek, & Newman, Inc. Cambridge, Massachusetts, for U.S. Minerals Management Service, Anchorage, Alaska.

Maniscalco, J. M., C. O. Matkin, D. Maldini, D. G. Calkins, and S. Atkinson. 2007. Assessing killer whale predation on Steller sea lions from field observations in Kenai Fjords, Alaska. Mar. Mamm. Sci. 23:306–321.

Mathisen, O. A., R. T. Baade, and R. J. Loff. 1962. Breeding habits, growth and stomach contents of the Steller sea lion in Alaska. Journal of Mammalogy 43(4):469-477.

Mate, B.R., K.M. Stafford and D.K. Ljungblad. 1994. A change in sperm whale (*Physeter macrocephalus*) distribution correlated to seismic surveys in the Gulf of Mexico. Journal of the Acoustical Society of America 96(2):3268-3269.

McCauley , R.D., J. Fewtrel, A.J. Duncan, C. Jener, M.N. Jener, J.D. Penrose, R.I.T. Prince, A. Adhitya, J. Murdoch, and K. McCabe. 2000. Marine seismic surveys: analysis of airgun signals, and effects of airgun exposure on humpback whales, sea turtles, fishes and squid. Report to APPEA by the Centre for Marine Science and Technology, Curtin University of Technology, Australia.

McDonald, M., J. Hildebrand, and S. Mesnick. 2009. Worldwide decline in tonal frequencies of blue whale songs. Endangered Species Research 9:13–21.

McKenna, M.F., D. Ross, S.M. Wiggins, and J.A. Hildebrand. 2012. Underwater radiated noise from modern commercial ships. Journal of the Acoustical Society of America 131:92-103.

Melcón M.L., A.J. Cummins, S.M. Kerosky, L.K. Roche, S.M. Wiggins, and J.A. Hildebrand. 2012. Blue whales respond to anthropogenic noise. PLoS ONE 7(2):e32681.

Merrick, R. L., & Calkins, D. G. (1996). Importance of juvenile walleye pollock, *Theragra chalcogramma*, in the diet of Gulf of Alaska Steller sea lions, *Eumetopias jubatus*. In R. D. Brodeur, P. A. Livingston, T. R. Loughlin, & A. B. Hollowed (Eds.), Ecology of juvenile walleye pollock

(*Theragra chalcogramma*) (NOAA Technical Report 126) (pp. 153-166). Washington, DC: U.S. Department of Commerce. 200 pp.

Merrick, R. L., T. R. Loughlin, and D. G. Calkins. 1987. Decline in abundance of the northern sea lion, *Eumetopias jubatus*, in 1956-86. Fish. Bull., U.S. 85:351-365.

Merrick, R. L., and T. R. Loughlin. 1997. Foraging behavior of adult female and young-of-the-year Steller sea lions in Alaskan waters. Can. J. Zool. 75:776–786.

Miles, P.R., C.I. Malme, and W.J. Richardson. 1987. Prediction of drilling site-specific interaction of industrial acoustic stimuli and endangered whales in the Alaskan Beaufort Sea. Report prepared by BBN Laboratories Inc., Cambridge, MA and LGL Ltd., King City, ON for the U.S. Department of the Interior Minerals Management Service, Alaska OCS Office, Anchorage, AK.

Mizroch, S. A. and D. W. Rice. 2006. Have North Pacific killer whales switched prey species in response to depletion of the great whale populations? Mar. Ecol. Prog. Ser. 310:235–246.

Mizroch, S. A., D. Rice, D. Zwiefelhofer, J. Waite, and W. Perryman. 2009. Distribution and movements of fin whales in the North Pacific Ocean. Mammal Rev. 39:193-227.

Moein-Bartol, S., J.A. Musick, and M.L. Lenhardt. 1999. Auditory evoked potentials of the loggerhead sea turtle (*Caretta caretta*). Copeia 1999: 836-840.Moore, S.E., K.W. Shelden, D.J. Rugh, B.A. Mahoney, and L.K. Litzky. 2000. Beluga, *Delphinapterus leucas*, habitat associations in Cook Inlet, Alaska. Mar. Fish. Rev. 62:60-80.

Moore, S. E., J. M. Waite, N. A. Friday and T. Honkalehto. 2002. Distribution and comparative estimates of cetacean abundance on the central and south-eastern Bering Sea shelf with observations on bathymetric and prey associations. Progr. Oceanogr. 55:249-262.

Moore M.J., J. der Hoop, S.G. Barco, A.M. Costidis, F.M. Gulland, P.D. Jepson, K.T. Moore, S. Raverty, and W.A. McLellan. 2013. Criteria and case definitions for serious injury and death of pinnipeds and cetaceans caused by anthropogenic trauma. Dis Aquat Organ. 103:229-64.

National Marine Fisheries Service. 1991. Recovery Plan for the Humpback Whale (*Megaptera novaeangliae*). Prepared by the Humpback Whale Recovery Team for the National Marine Fisheries Service, Silver Spring, Maryland. 105 pp.

National Marine Fisheries Service. 1994. Final Rule to Remove the Eastern North Pacific Population of the Gray Whale from the List of Endangered Wildlife. Fed. Regist. 59:31094-31095.

National Marine Fisheries Service and U.S. Fish and Wildlife Service. 1998a. Recovery plan for U.S. Pacific populations of the leatherback turtle (*Dermochelys coriacea*). National Marine Fisheries Service, Silver Spring, Maryland. 65 pp.

National Marine Fisheries Service and U.S. Fish and Wildlife Service. 1998b. Recovery plan for U.S. Pacific populations of the leatherback turtle (*Dermochelys coriacea*). National Marine Fisheries Service, Silver Spring, Maryland. 84 pp.

National Marine Fisheries Service and U.S. Fish and Wildlife Service. 1998c. Recovery plan for U.S. Pacific populations of the loggerhead turtle (*Caretta caretta*). National Marine Fisheries Service, Silver Spring, Maryland. 59 pp.

National Marine Fisheries Service. 2008a. Recovery Plan for Southern Resident Killer Whales (*Orcinus orca*). National Marine Fisheries Service, Northwest Region, Seattle, Washington.

National Marine Fisheries Service. 2008b. Conservation Plan for the Cook Inlet beluga whale (*Delphinapterus leucas*). National Marine Fisheries Service, Juneau, Alaska.

National Marine Fisheries Service. 2008c. Recovery Plan for the Steller Sea Lion (*Eumetopias jubatus*). Revision. National Marine Fisheries Service, Silver Spring, MD. 325 pp.

National Marine Fisheries Service. 2008d. Final rule to implement speed restrictions to reduce the threat of ship collisions with North Atlantic right whales. Fed Regist. 73: 60173−60191.

National Marine Fisheries Service. 2010. Recovery plan for the sperm whale (*Physeter macrocephalus*). National Marine Fisheries Service, Silver Spring, MD. 165 pp.

National Marine Fisheries Service. 2011. Final Recovery Plan for the Sei Whale (*Balaenoptera borealis*). National Marine Fisheries Service, Office of Protected Resources, Silver Spring, MD. 108 pp.

National Marine Fisheries Service and U.S. Fish and Wildlife Service. 2013. Leatherback Sea Turtle (*Dermochelys coriacea*) 5-Year Review: Summary and Evaluation. National Marine Fisheries Service, Silver Spring, Maryland and U.S. Fish and Wildlife Service Jacksonville, Florida. 89 pp.

National Marine Fisheries Service. 2013. Final Recovery Plan for the North Pacific Right Whale (*Eubalaena japonica*). National Marine Fisheries Service, Office of Protected Resources, Silver Spring, MD.

National Research Council (NRC). 2003. Ocean Noise and Marine Mammals. National Academies Press, Washington, D.C. 192 pp.

National Research Council (NRC). 2014. Responding to Oil Spills in the U.S. Arctic Marine Environment. National Academies Press, Washington, D.C. 183 pp.

Neilson, J.L., C.M. Gabriele, A.S. Jensen, K. Jackson, and J.M. Straley. 2012. Summary of reported whale-vessel collisions in Alaskan waters. Journal of Marine Biology 2012:1-18.

Nemeth, M. J., C. C. Kaplan, A. M. Prevel-Ramos, G. D. Wade, D. M. Savarese, and C. D. Lyons. 2007. Baseline studies of marine fish and mammals in Upper Cook Inlet, April through October 2006. Final report prepared by LGL Alaska Research Associates, Inc., Anchorage, Alaska for DRven Corporation, Anchorage, Alaska.

Nemoto, T. 1957. Foods of baleen whales in the northern Pacific. Sci. Rep. Whales Res. Inst. Tokyo: 1233-89.

Nichol, L. M., E. J. Gregr, R. Flinn, J. K. B. Ford, R. Gurney, L. Michaluk and A. Peacock. 2002. British Columbia commercial whaling catch data 1908 to 1967: A detailed description of the B.C. historical whaling database. Canadian Technical Report of Fisheries and Aquatic Sciences 2396.

Odom, M.C., D.J. Orth, and L.A. Nielsen. 1992. Investigation of barge-associated mortality of larval fishes in the Kanawha River. Virginia Journal of Science 43:41-45.

O'Hara, J. and J.R. Wilcox. 1990. Avoidance responses of loggerhead turtles, *Caretta caretta,* to low frequency sound. Copeia 1990: 564-567.

Ohsumi, S., and S. Wada. 1972. Stock assessment of blue whales in the North Pacific. Unpublished working paper for the 24th meeting of the Scientific Committee of the International Whaling Commission, 20 pp.

Ohsumi, S. and S. Wada. 1974. Status of whale stocks in the North Pacific, 1972. Reports of the International Whaling Commission, 25:114-126.

Ohsumi, S. 1986. Yearly change in age and body length at sexual maturity of a fin whale stock in the eastern North Pacific. Sci. Rep. Whales Res. Inst. 37:1-16.

Olesiuk, P. F., G. M. Ellis, and J. K. Ford. 2005. Life history and population dynamics of northern resident killer whales (*Orcinus orca*) in British Columbia. DFO Canadian Science Advisory Secretariat Research Document 2005/045.

Omura, H. 1958. North Pacific right whale. Scientific Reports of the Whales Research Institute, Tokyo. 13:1-52.

Omura, H. 1986. History of right whale catches in the waters around Japan. Reports of the International Whaling Commission Special Issue. 10:35-41.

Omura, H., S. Ohsumi, K.N. Nemoto, K. Nasu, and T. Kasuya. 1969. Black right whales in the North Pacific. Scientific Reports of the Whales Research Institute, Tokyo. 21:1-78.

Omura, H., and S. Ohsumi. 1974. Research on whale biology of Japan with special reference to the North Pacific stocks. Pp. 196-208 In: Schevill, W.E (ed.) The whale problem: a status report. Harvard University Press, Cambridge, MA. 419 pp.

Panigada, S., Pesante, G., Zanardelli, M., Capoulade, F., Gannier, A., and Weinrich, M. T. 2006. Mediterranean fin whales at risk from fatal ship strikes. Marine Pollution Bulletin 52:1287-1298.

Papanikolaou, A., E. Eleftheria, A. Aimilia, A, Seref, T. Cantekin, D. Severine, and M. Nikos. 2006. Impact of Hull Design on Tanker Pollution. Proceedings of the Ninth International Marine Design Conference, Ann Arbor, MI.

PAWSA (Ports and Waterways Safety Assessment) Workshop Report Aleutian Islands. July 24-25, 2006.

Pitcher, K.W. and D.G. Calkins. 1981. Reproductive biology of Steller sea lions in the Gulf of Alaska. Journal of Mammalogy 62:599-605.

Pitman, R.L., and S.J. Chivers. 1998. Terror in black and white. Natural History 107:26-29.

Rankin, S., J. Barlow, and K.M. Stafford. 2006. Blue whale (*Balaenoptera musculus*) sightings and recordings south of the Aleutian Islands. Marine Mammal Science 22:708-713.

Raum-Suryan, K. L., K. Pitcher, D. G. Calkins, J. L. Sease and T. R. Loughlin. 2002. Dispersal, rookery fidelity, and metapopulation structure of Steller sea lions (*Eumetopias jubatus*) in an increasing and a decreasing population in Alaska. Marine Mammal Science 18:746–764.

Reeves, R. R., P. J. Clapham, R. L. J. Brownell, and G. K. Silber. 1998. Recovery plan for the blue whale (*Balaenoptera musculus*). National Marine Fisheries Service, Office of Protected Resources, Silver Spring, MD.

Reeves, R., B. Stewart, P. Clapham, J. Powell. 2002. National Audubon Society Guide to Marine Mammals of the World. New York: Alfred A. Knopf.

Rice, D.W. 1963. Progress report on biological studies of the larger Cetacea in the waters off California. Norsk Hvalfangst-tid. 52:181-187.

Rice, D.W. 1974. Whales and whale research in the eastern North Pacific. In: Schevill, W.E. (ed.), The whale problem: a status report. Harvard University Press, Cambridge, MA. Pp. 170-195.

Rice, D. 1977. Synopsis of biological data on the sei whale and Bryde's whale in the eastern North Pacific. Report of the International Whaling Commission Special Issue 1:333-336.

Rice, D.W. 1986. Blue whale. In: D. Haley (ed.) Marine mammals of eastern North Pacific and Arctic waters. Second edition. Pacific Search Press. Pp. 4-45.

Rice, D.W. 1989. Sperm whale *Physeter macrocephalus Linnaeus*, 1758. Pp. 177–233 in S.H. Ridgway and R. Harrison (eds.), Handbook of marine mammals, vol. 4. Academic Press, London.

Rice, D. W. 1998. Marine mammals of the world: Systematics and distribution. Special Publication Number 4. The Society for Marine Mammology, Lawrence, KS. 231 pp.

Richardson, W.J., M.A. Fraker, B. Würsig, and R.S. Wells. 1985. Behaviour of bowhead whales, *Balaena mysticetus*, summering in the Beaufort Sea: Reactions to industrial activities. Biological Conservation 32:195-230.

Richardson, W.J., B. Würsig, and C.R. Greene Jr. 1990. Reactions of bowhead whales, *Balaena mysticetus*, to drilling and dredging noise in the Canadian Beaufort Sea. Marine Environmental Research, 29:135-160.

Richardson, W.J. and C.I. Malme. 1993. Man-made noise and behavioral responses. In J. J. Burns, J. J. Montague, & C. J. Cowles (Eds.), The bowhead whale (Special Publication 2) (pp. 631-700). Lawrence, KS: Society for Marine Mammalogy. 787 pp.

Richardson, W.J., C.R. Greene, C.I. Malme, and D.H. Thompson. 1995. Marine Mammals and Noise. Academic Press, San Diego, CA. 576 pp.

Ridgway, S.H., E.G. Wever, J.G. McCormick, J. Palin, and J.H. Anderson. 1969. Hearing in the giant sea turtle, *Chelonia mydas*. Proc. Natl. Acad. Sci. 64, 884-890.

Romero L.M., M.J. Dickens, and N.E. Cyr. 2009. The reactive scope model – a new model integrating homeostasis, allostasis and stress. Horm. Behav. 55:375–389.

Saracco, J. F., C. M. Gabriele, and J. L. Neilson. 2013. Population dynamics and demography of humpback whales in Glacier Bay and Icy Strait, Alaska. Northwestern Naturalist 94:187-197.

Saricks, C.L. and M.M. Tompkins. 1999. State-Level Accident Rates of Surface Freight Transportation: A Reexamination. Argonne National Laboratory publication ANL/ESD/TM-150. 62 pp.

Sarti Martínez, L., A.R. Barragán, D.G. Muñoz, N. Garcia, P. Huerta, and F. Vargas. 2007. Conservation and biology of the leatherback turtle in the Mexican Pacific. Chelonian Conservation and Biology 6:70-78.

Scarff J.E. 2001. Preliminary estimates of whaling-induced mortality in the 19th century North Pacific right whale (*Eubalaena japonicas*) fishery, adjusting for struck-but-lost whales and non-American whaling. Journal of Cetacean Research Management (Special Issue) 2:261-268.

Scheffer, V. B. and J. W. Slipp. 1948. The whales and dolphins of Washington State with a key to the cetaceans of the west coast of North America. American Midland Naturalist 39:257-337.

Scheifele, P.M., S. Andrew, R.A. Cooper, M. Darre, F.E. Musiek, and L. Max. 2005. Indication of a Lombard vocal response in the St. Lawrence River beluga. Journal of Acoustics Society of America 117:1486-1492.

Sergeant, D.E. 1973. Biology of white whales (*Delphinapterus leucas*) in western Hudson Bay. J Fish Res Bd Can 30:1065-90.

Sears, R. 1990. The Cortez blues. Whalewatcher 24:12-15.

Shelden, K.E.W., D.J. Rugh, B.A. Mahoney, and M.E. Dahlheim. 2003. Killer whale predation on beluga whale in Cook Inlet, Alaska: Implications for a depleted population. Marine Mammal Science: 19:529–544.

Silber, G. K. and S. Bettridge. 2012. An assessment of the final rule to implement vessel speed restrictions to reduce the threat of vessel collisions with North Atlantic Right Whales. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-OPR-48.

Silber, G. K., J. Slutsky, and S. Bettridge. 2010. Hydrodynamics of a ship/whale collision. Journal of Experimental Marine Biology and Ecology 36:10-19.

Simmonds, M., S. Dolman, and L. Weilgart. 2004. Ocean of noise – A WDCS Science report. Whale and Dolphin Conservation Society. 164 pp.

Southall, B.L., R.J. Schusterman, and D. Kastak. 2000. Masking in three pinnipeds: Underwater, low-frequency critical ratios. J. Acoust. Soc. Am. 108, 1322–1326.

Spaven, L.D., J.K.B. Ford, and C. Sbrocchi. 2009. Occurrence of leatherback sea turtles (*Dermochelys coriacea*) off the Pacific Coast of Canada, 1931-2009. Canadian Technical Report of Fisheries and Aquatic Sciences 2858. 32 pp.

Speckman, S.G., and Piatt, J.F. 2000. Historic and current use of lower Cook Inlet, Alaska, belugas, *Delphinapterus leucas*. Marine Fisheries Review 62:22-26.

Spotila, J.R., R.D. Reina, A.C. Steyermark, P.T. Plotkin, and F.V. Paladino. 2000. Pacific leatherback turtles face extinction. Nature 405:529-530.

Stafford, K.M., S.L. Nieukirk, and C.G. Fox, 2001: Geographic and seasonal variation of blue whale calls in the North Pacific. J. Cet. Res. & Mgt. 3:65-76.

Stafford, K.M. 2003. Two types of blue whale calls recorded in the Gulf of Alaska. Marine Mammal Science 19:682-693.

Tarpy, C. 1979. Killer whale attack! National Geographic 155:542-545.

Thorsteinson, F.V. and C.J. Lensink. 1962. Biological observations of Steller sea lions taken during an experimental harvest. Journal of Wildlife Management 26:353-359.

Tillman, M. F. 1977. Estimates of population size for the North Pacific sei whale. Reports of the International Whaling Commission, Special Issue 1:98-106.

Tynan, C.T., D.P. Demaster, and W.T. Peterson. 2001. Endangered right whales on the southeastern Bering Sea shelf. Science. 294:1894.

Tønnessen JN, Johnsen AO. 1982. The History of Modern Whaling. University of California Press: Berkeley, CA.

Transportation Research Board (TRB). 2008. Risk of Vessel Accidents and Spills in the Aleutian Islands. TRB Special Report 293, National Academy of Sciences, Washington, D.C. 225 pp.

Van Waerebeek, K., Baker, A. N., Felix, F., Gedamke, J., Inigues, M., Sanino, G. P., Secchi, E., Sutaria, D., van Helden, A., Wang, Y. 2007. Vessel collisions with small cetaceans worldwide and with large whales in the Southern Hemisphere, and initial assessment. Latin American Journal of Aquatic Mammals 6:43-69.

Vanderlaan, A.S.M., and C.T. Taggart. 2007. Vessel collisions with whales: The probability of lethal injury based on vessel speed. Marine Mammal Science, 23:144-156.

Van Dorp, J.R. and J. Merrick. 2014. VTRA 2010 Final Report. Preventing oil spills from large ships and barges In Northern Puget Sound & Strait of Juan de Fuca. Washington State Puget Sound Partnership.

Venizelos, L.E. 1993. Speed boats kill turtles in Laganas Bay, Zakynthos. Marine Turtle News, Vol. 63, pp. 15.

Vos, D.J. and K.E.W. Shelden. 2005. Unusual mortality in the depleted Cook Inlet beluga population. Northwest. Nat. 86:59-65.

Wade P. R., V. N. Burkanov, M. E. Dahlheim, N. A. Friday, L. W. Fritz, T. R. Loughlin, S. A. Mizroch, M. M. Muto, D. W. Rice, L. G. Barrett-Lennard, N. A. Black, A. M. Burdin, J. Calambokidis, S. Cerchio, J. K. B. Ford, J. K. Jacobsen, C. O. Matkin, D. R. Matkin, A. V. Mehta, R. J. Small, J. M. Straley, S. M. McCluskey, and G. R.VanBlaricom. 2007. Killer whales and marine mammal trends in the North Pacific—a re-examination of evidence for sequential megafauna collapse and the prey-switching hypothesis. Mar. Mamm. Sci. 23:766–802.

Wade, P. R., A. Kennedy, R. LeDuc, J. Barlow, J. Carretta, K. Shelden, W. Perryman, R. Pitman, K. Robertson, B. Rone, J. C. Salinas, A. Zerbini, R. L. Brownell, and P. J. Clapham. 2011a. The world's smallest whale population? (*Eubalaena japonica*). Biology Letters. 7(1):83-85.

Wade, P. R., A. D. Robertis, K. R. Hough, R. Booth, A. Kennedy, R. G. LeDuc, L. Munger, J. Napp, K. E. W. Shelden, S. Rankin, O. Vasquez, and C. Wilson. 2011b. Rare detections of North Pacific right whales in the Gulf of Alaska, with observations of their potential prey. Endangered Species Research. 13:99-109.

Waite, J.M., K. Wynne, and D.K. Mellinger. 2003. Documented sighting of a North Pacific right whale in the Gulf of Alaska and post-sighting acoustic monitoring. Northwestern Naturalist. 84:38-43.

Washington Department of Ecology. 2014. VEAT 2013: Vessel Entries and Transits for Washington Waters. Available at https://fortress.wa.gov/ecy/publications/publications/1408004.pdf

Wartzok, D. and D.R. Ketten. 1999. Marine Mammal Sensory Systems. In: J. E. Reynolds III & S. A. Rommel (eds) Biology of Marine Mammals. Smithsonian Institution Press, Herndon, Virginia. Pp. 117–175.

Watkins, W.A. and W.E. Schevill. 1975. Sperm whales (*Physeter catodon*) react to pingers. Deep-Sea Research 22: 123-129.

Watkins, W.A, K.E. Moore, D. Wartzok, and J.H. Johnson. 1981. Radio tracking of finback (*Balaenoptera physalus*) and humpback (*Megaptera novaeangliae*) in Prince William Sound, Alaska. Deep-Sea Res. 28:577-588.

Watkins, W.A. 1986. Whale reactions to human activities in Cape Cod waters. Marine Mammal Science 2:251-262.

Weilgart, L. 2007. The impacts of anthropogenic ocean noise on cetaceans and implications for management. Can J Zool 85:1091–1116.

Weller D.W., A.M. Burdin, B. Würsig, B.L. Taylor, and R.L. Jr. Brownell. 2002. The western Pacific gray whale: a review of past exploitation, current status and potential threats. J Cetacean Res Manag 4:7−12.

Weller D.W., A. Klimek, A.L. Bradford, J. Calambokidis, A.R. Lang, B. Gisborne, A.M. Burdin, W. Szaniszlo, J. Urban, A. Gomez-Gallardo Unzueta, S. Swartz, and R.L. Jr Brownell. 2012. Movements of gray whales between the western and eastern North Pacific. Endangered Species Research 18:193-199.

Whitehead, H. 2002. Estimates of the current global population size and historical trajectory for sperm whales. Mar. Ecol. Prog. Ser. 242:295-304.

Whitehead, H. 2003. Sperm whales: social evolution in the ocean. University of Chicago Press, Chicago, IL.

Williams TM, Fuiman LA, Horning M, and Davis RW. 2004. The cost of foraging by a marine predator, the Weddell seal *Leptonychotes weddellii*: pricing by the stroke. J Exp Biol 207:973 – 982.

Williams R., D.E. Bain, J.C. Smith, and D. Lusseau. 2009. Effects of vessels on behaviour patterns of individual southern resident killer whales *Orcinus orca*. Endangered Species Research 6:199-209.

Zerbini, A. N., J. M. Waite, J. L. Laake, and P. R. Wade. 2006. Abundance, trends and distribution of baleen whales off western Alaska and the central Aleutian Islands. Deep-Sea Res. Part I:1772-1790.

DRAFT

U.S. Fish & Wildlife Service

Biological Assessment – Section 7

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ACRONYMS AND ABBREVIATIONS

% .... percent
μPa .... micropascal
AAC .... Alaska Administrative Code
ADEC............... Alaska Department of Environmental Conservation
bbl .... barrels
Bbbl................. billion barrels
CFR.................. Code of Federal Regulation
CWA .... Clean Water Act
dB..................... decibel
Donlin Gold ..... Donlin Gold, LLC
DPS .... Alaska Distinct Population Segment
EPA.................. U.S. Environmental Protection Agency
ESA.................. Endangered Species Act
FRP .... Facility Response Plans
ft....................... foot/feet
h .... hour
Hz..................... hertz
kHz................... kilohertz
km .... kilometer
kt .... knot/knots
m .... meter
mi .... statute mile
MSGP............... Multi-sector General Permit
NMFS............... National Marine Fisheries Service
ODPCP............. oil discharge prevention and contingency plan
PTS................... permanent threshold shift
r .... radius
RHA .... Rivers and Harbors Act
rms .... root mean square
TRB.................. Transportation Research Board
TSS................... Traffic Separation Scheme
TTS .... temporary threshold shift
U.S. .... United States
USACE .... U.S. Army Corps of Engineers
USFWS………. U.S. Fish and Wildlife Service
USCG............... U.S. Coast Guard
WDFW............. Washington Department of Fish and Wildlife
WQS................. Water Quality Standards

1. INTRODUCTION

In July 2012, Donlin Gold submitted a preliminary permit application, as per Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act (CWA), to the U.S. Army Corps of Engineers (USACE) to develop an open pit, hardrock gold mine approximately 10 miles (mi) (16 kilometers [km]) north of the village of Crooked Creek, in western Alaska. The proposed Donlin Gold Project has four primary components: 1) mine site facilities, 2) a 315-mi (507-km) natural gas pipeline, 3) oceanic supply barging, and 4) river supply barging. All barging will occur in the ice free months from May to September. The marine barging components of the project could encounter species listed under the Endangered Species Act (ESA) at locations described in this report.

Six species under ESA jurisdiction of the United States Fish and Wildlife Service (USFWS) are evaluated in this Biological Assessment (BA) on the potential and magnitude of effect of activities to each of the listed species. Activities of the proposed project that could affect the listed species include: noise from vessel propulsion, vessel strikes, accidental spill, incidental spill, and effects to prey. This BA also provides substantial detail on the listed species distribution, feeding, reproduction, natural mortality, and use of the proposed action area, all of which are necessary to conduct the detailed effects analysis.

2. ACTION AREA AND LOGISTICS

The Donlin Gold Project action area includes the following proposed project components: mine site; natural gas pipeline; access road; Jungjuk Port; river transportation route; and the marine barging routes. Only the marine barging routes are addressed in this BA as they are the only Project component intersecting habitat used by species under the ESA. The marine barging routes extend from the mouth of the Kuskokwim River, in Kuskokwim Bay, to sea ports in Dutch Harbor and Seattle. This action area is very broad and larger than the scope used in the analyses included in the Draft Environmental Impact Statement. USFWS conformity with this action area has not taken place pending the start of future informal consultation. Thus this action area could change in the future. Changes in the action area could increase or decrease the number of potentially affected species addressed in this biological assessment.

Donlin Gold's proposed oceanic barging program consists of four marine barging routes as described:

1. **Pacific Offshore Route**: a 2,100-mi (3,380-km) barge route between Seattle and Unimak Pass following the Great Circle route (Figure 1a and Figure 1b),
2. **Pacific Inshore Route**: a 2,400-mi (3,862-km) route between Seattle and Unimak Pass following an inside passage route (Figure 2a, Figure 2b, Figure 2c, and Figure 2d),
3. **Bering Route**: a 520-mi (837-km) route between Dutch Harbor and the Kuskokwim River that includes the 470-mi (756-km) route between Unimak Pass and the Kuskokwim (Figure 3), and
4. **Cook Inlet Route**: a 40-mi (64-km) supply barge route between Anchorage and a barge landing south of Beluga (Figure 4).

The Pacific Offshore Route includes the marine inland waters of Washington State, and nearshore and offshore marine waters in the North Pacific and the Gulf of Alaska, while the Pacific Inshore Route follows inland and shelf waters from Puget Sound, through the inside passage, and inshore of Kodiak Island and the Shumagin Islands. The route is evaluated with Seattle as the launch point, although some cargo barges may launch from Vancouver (lessening the Pacific Inshore route by 120 mi [193 km]). The Bering Route includes the harbor waters of Dutch Harbor, and Bristol and Kuskokwim bays within the Bering Sea. Route lines in the figures are the best approximation of the routes to be followed. Actual routes may vary from those depicted in the figures, but not appreciably enough to alter the effects analysis results presented in this assessment.

Barging of cargo from the west coast ports will occur between May and September when all waters are clear of ice, and seasonal storms have abated. Barging will take place over the estimated 4 years of mine construction and the 27.5 years of operation. During operations three sets of cargo barges launching from Seattle or Vancouver will make approximately 12 trips (24 transits) annually, each round-trip taking about 32 days. Each barge will have a deadweight capacity of 11,500 tons (10,433 tonnes) and a net cargo capacity of 9,480 tons (8,600 tonnes), and will be hawser-towed by a 4,200-horsepower oceanic tugboat. Cargo will include annual consumables and general cargo consolidated as bulk in containers, bulk in super-sacks, loose or palletized break-bulk, small packages, and liquid in small tanks. Included in this cargo are a number of chemicals required in gold processing. The list and annual amount of chemicals that will be transported to and from the mine are found in Table 1.

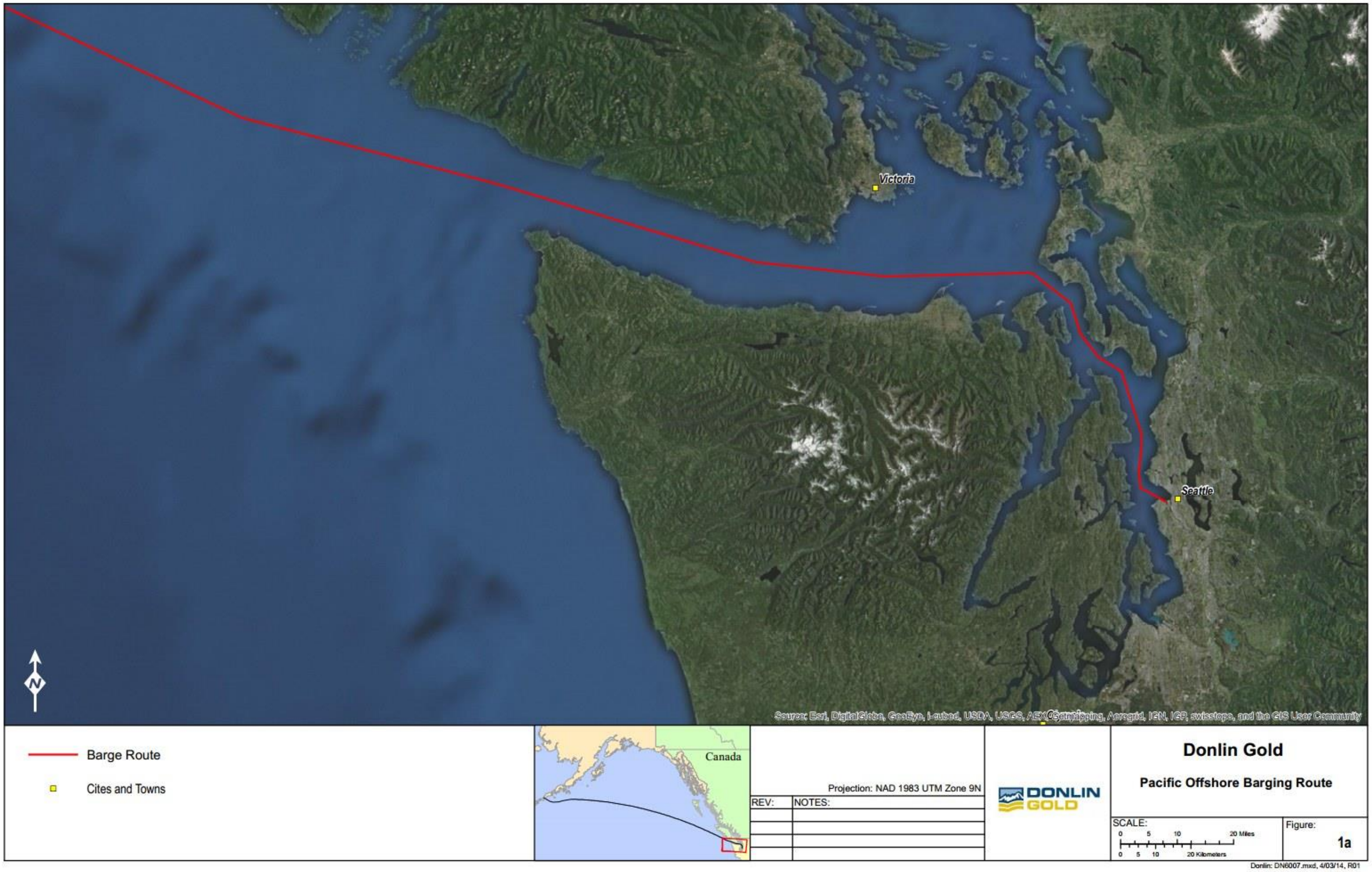

FIGURE 1A: PACIFIC OFFSHORE BARGING ROUTE

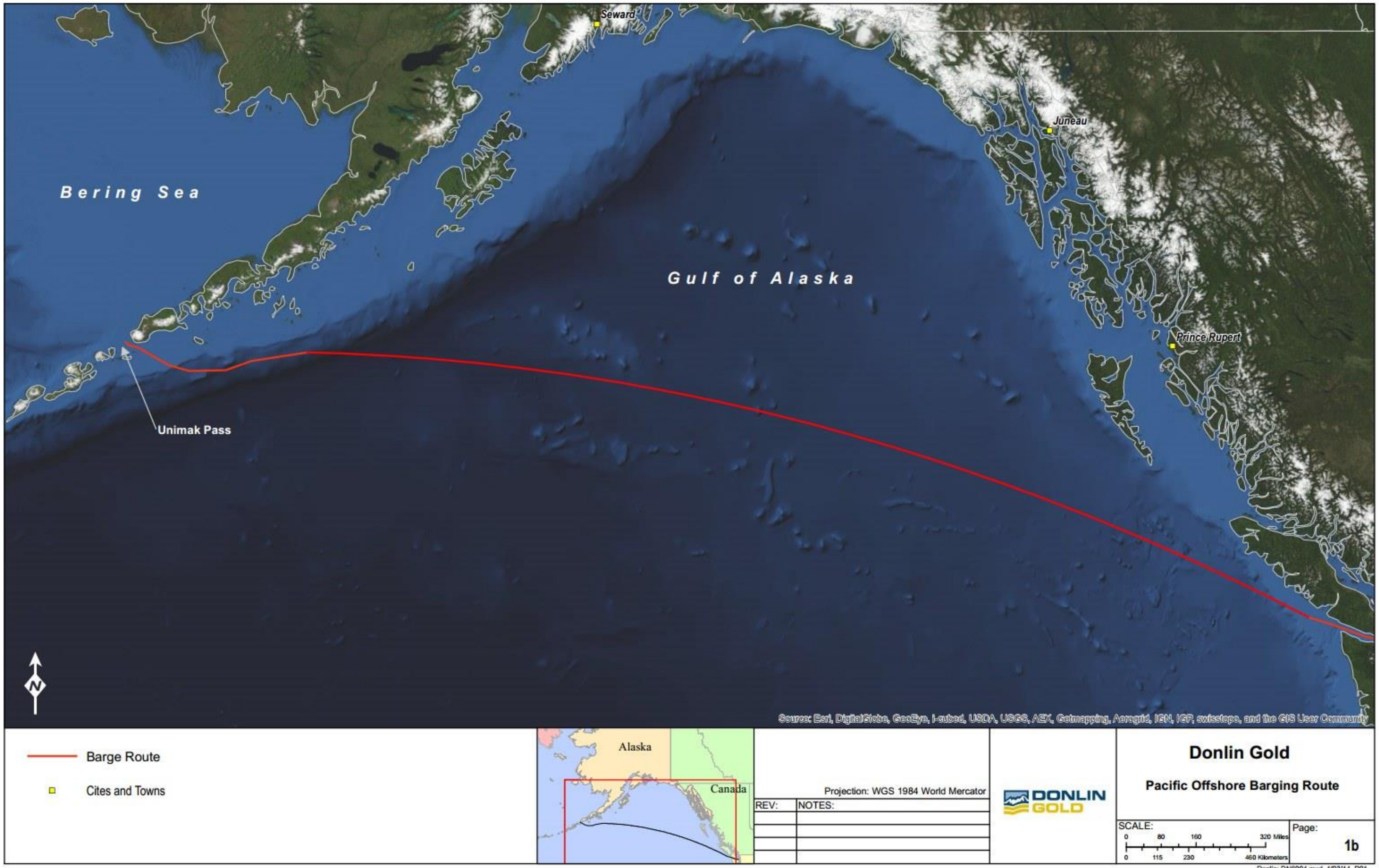

FIGURE 1B: PACIFIC OFFSHORE BARGING ROUTE

FIGURE 2A: PACIFIC INSHORE BARGING ROUTE

FIGURE 2B: PACIFIC INSHORE BARGING ROUTE

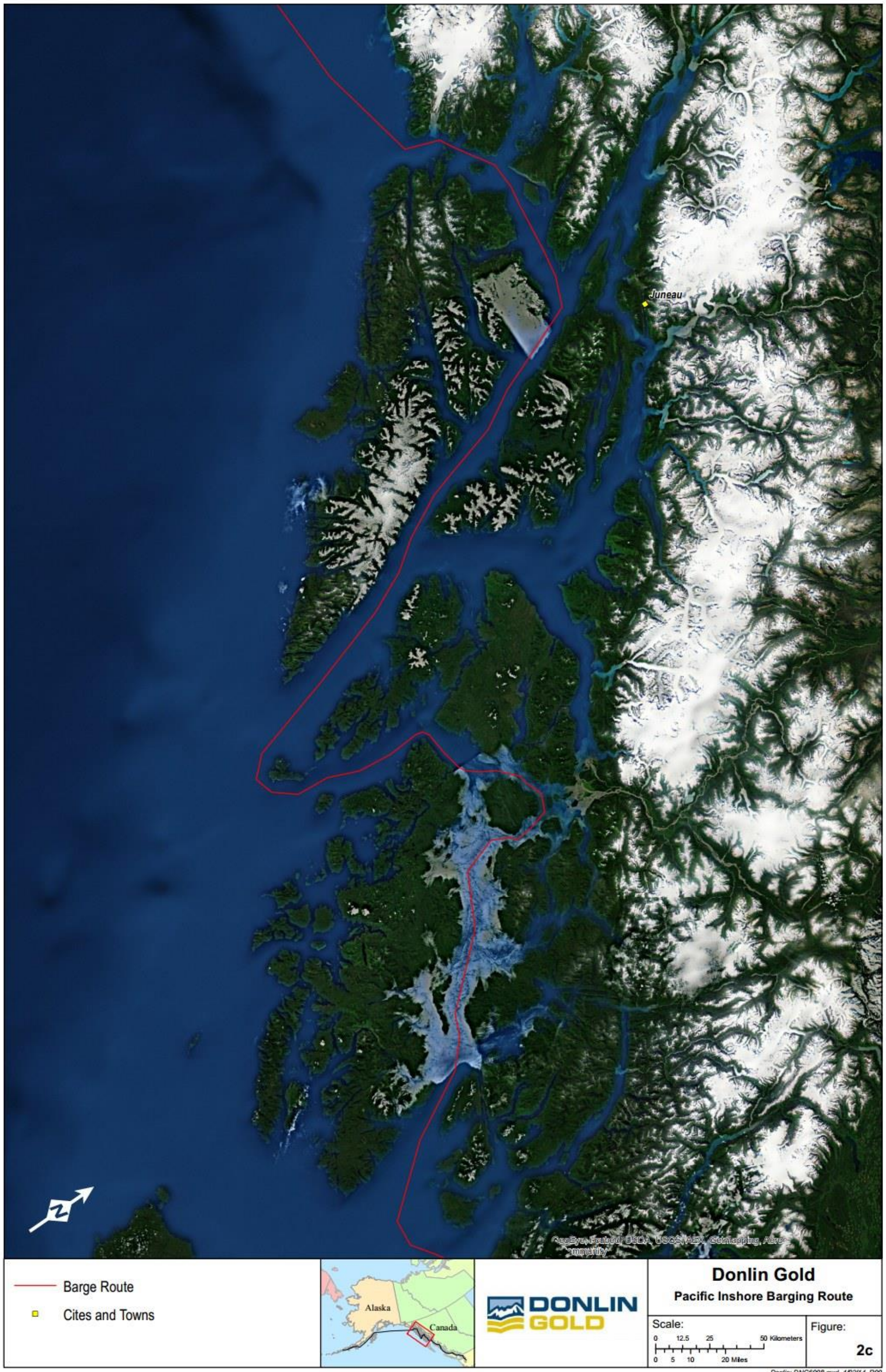

FIGURE 2C: PACIFIC INSHORE BARGING ROUTE

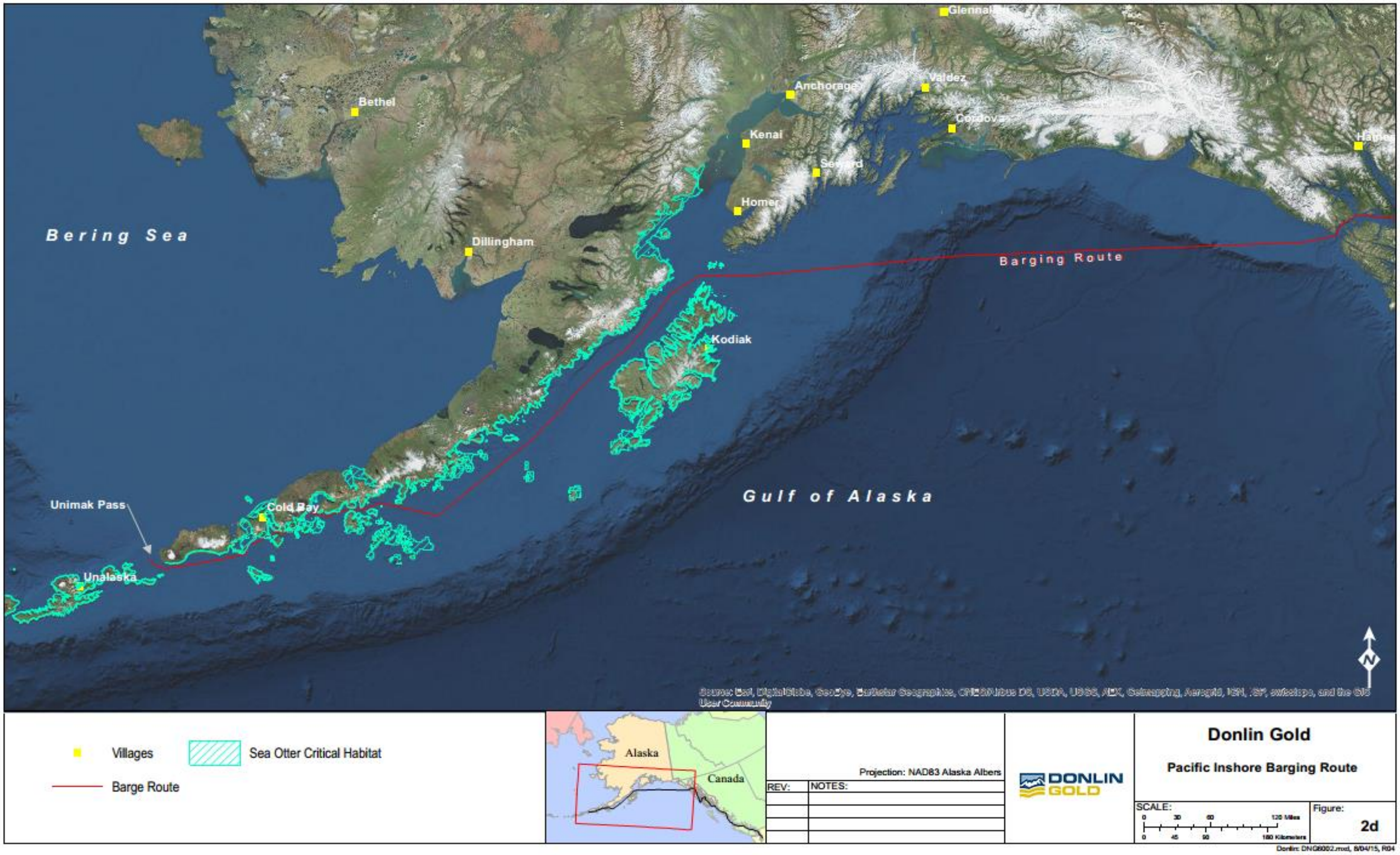

FIGURE 2D: PACIFIC INSHORE BARGING ROUTE

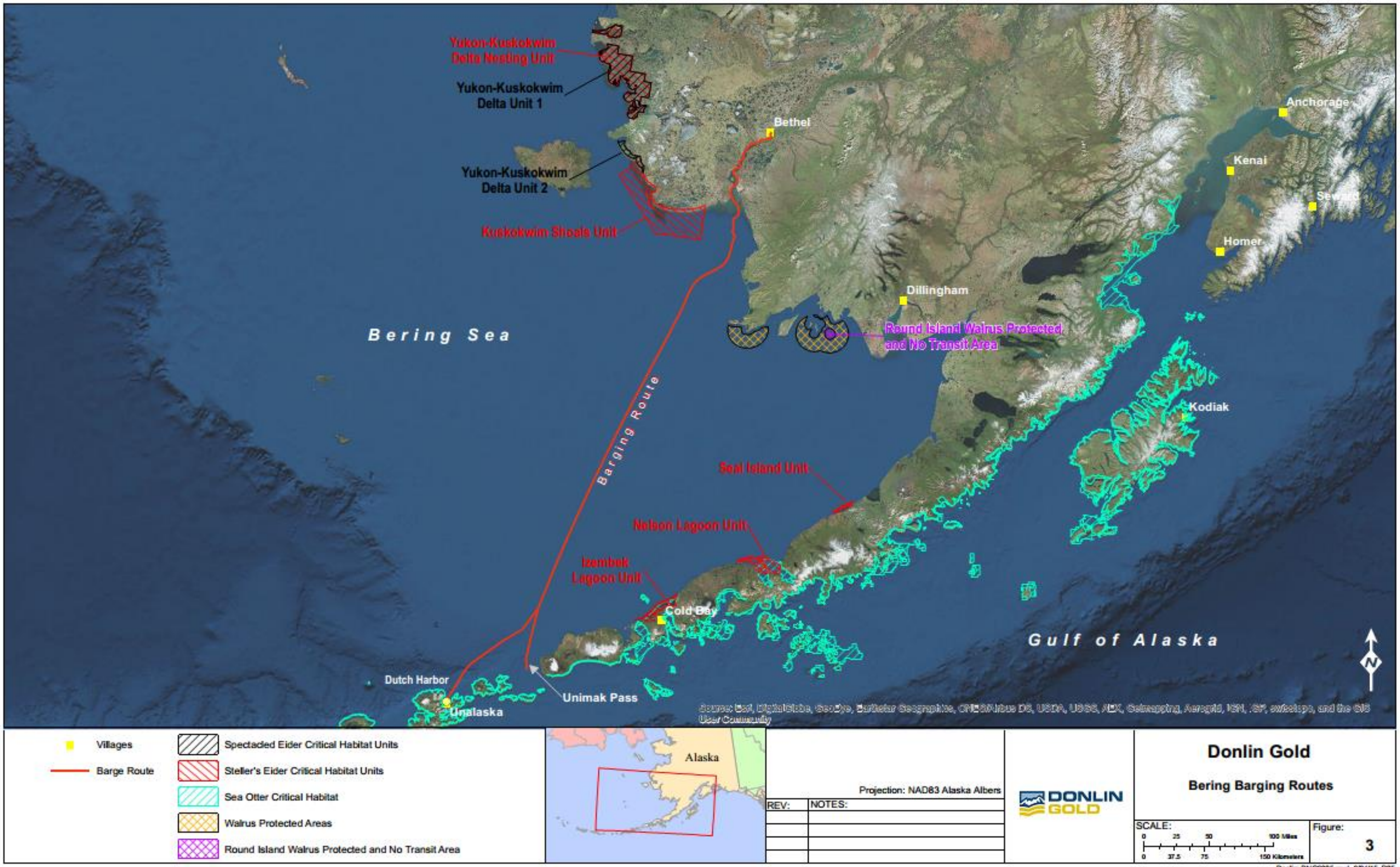

FIGURE 3: BERING BARGING ROUTES

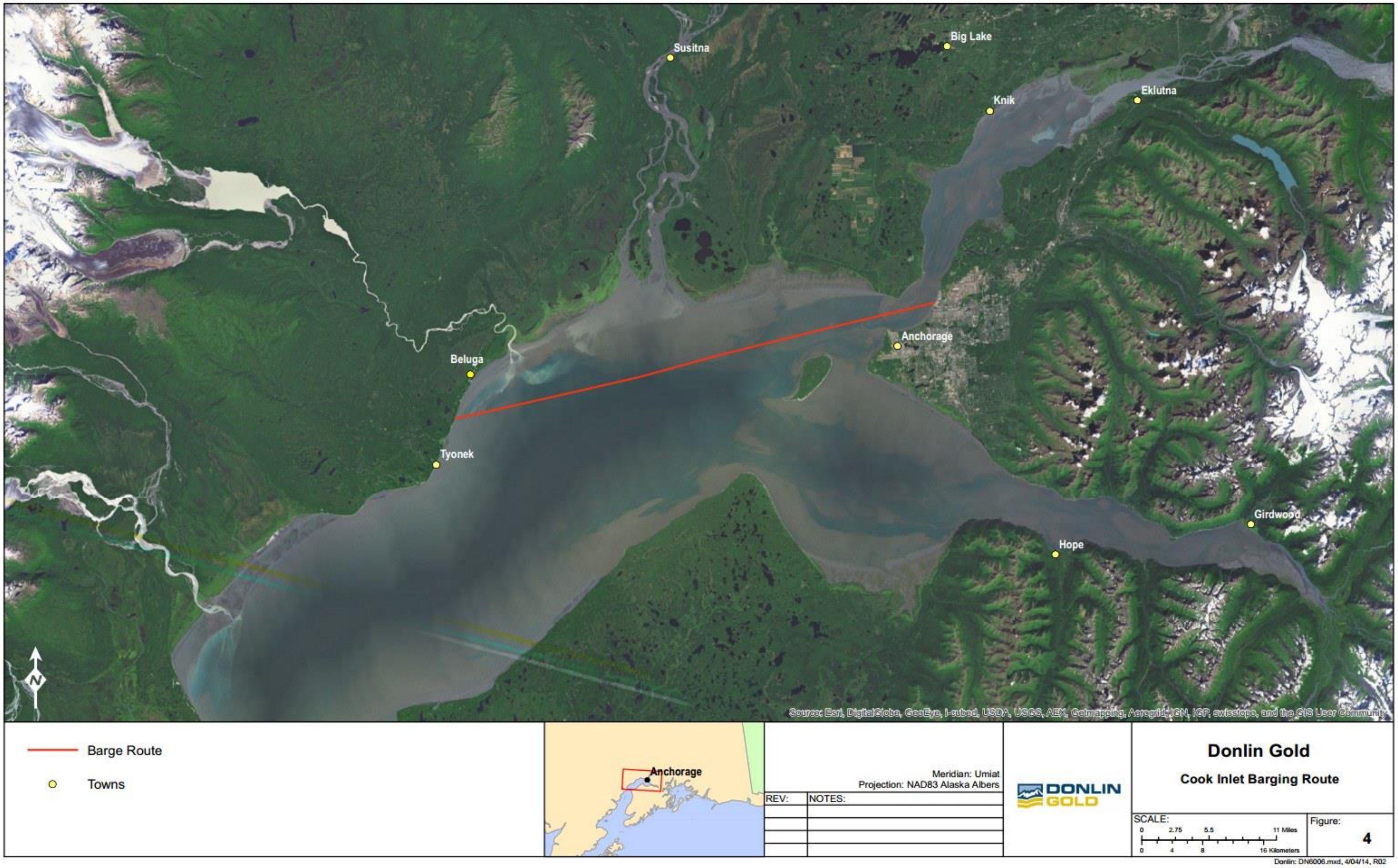

FIGURE 4: COOK INLET BARGING ROUTES

TABLE 1: KEY CHEMICALS TRANSPORTED ANNUALLY DURING MINE OPERATION PHASE.

Chemicals[1]	Estimated Annual Transport (Short Tons)
Ammonium Nitrate (bulk)	33,000
Potassium Amyl Xanthate	4,189
Methyl Isobutyl Carbinol and F-549	1,984
Nitric Acid	661
Sodium Cyanide	2,535
Lime	21,027
Activated Carbon	220
Caustic soda (Sodium hydroxide)	358
Mercury Suppressant (UNR 829)	44
Flocculants	3,527
Sulfur	1,414
Copper sulfate	2,425
Fluxes (borax, sodium nitrate, and silica sand)	165
Water Softening and Anti-Scalant Agents[2]	1,081
Ferric Sulphate[3]	440
Sulphuric Acid[3]	18
Sodium hydroxide[3]	13
Polymer[3]	2
Potassium Permangenate[3]	13
Sodium Metabisulfite[3]	7
Cleaning-In-Place (HCl, NaOH)[3]	Less than 1 (~ 250 lbs)
Microsand[3]	8
Liquid Elemental Mercury	11
Spent Activated Carbon (Mercury)	5.5

[1]- The estimates are based on the current level of engineering design, and are applicable only to the mine operations phase. These chemicals would not be required during construction or the reclamation and closure phase of the project. The list of chemical amounts is subject to change along with future engineering design. Additional chemicals could/would be added, substituted, or amounts increased or decreased.

[2]- Includes 17 short tons of Anti-Scalant Agent required for the AWT.

[3]- Required for AWT.

During operations fuel will be transported from Dutch Harbor to Bethel using a single double-hulled barge holding up to 2.9 million U.S. gallons of fuel towed by a 3,000 horsepower tug. Fuel demand varies over the mine life, but at the peak of operations will require a maximum of about 14 barge trips per year across

Kuskokwim Bay. Fuel demands during construction are significantly lower and would require between 3 and 6 trips per year.

Up to 20 construction barge trips (40 transits) will run from Anchorage to Beluga, but all trips will occur within one construction season, and gas line pipe will be the primary cargo. The beach landing site is 3.8 mi (6.1 km) south of the Beluga Airport and 7.3 mi (11.7 km) south of the mouth of the Beluga River.

3. SPECIES POTENTIALLY AFFECTED

Two species of marine mammals, two species of seabirds, and two species of sea ducks, are currently listed, or are candidates for listing, under the ESA, and occur seasonally or year-round along the marine barging routes proposed by Donlin Gold (Table 2). Northern sea otters are found along the Pacific Inshore route from British Columbia throughout Alaska, including the Bering Sea side of the Alaska Peninsula and eastern Aleutian Islands; only those sea otters west of Cook Inlet are listed under the ESA. Several thousand male Pacific walrus summer in the Bering Sea, hauling out at Round Island, Cape Peirce, and Cape Newhalem, and a few lesser used sites. Marbled murrelets can be found in nearshore waters from Washington to Prince William Sound, but only those occurring along barging routes in Washington State are listed under the ESA. Short-tailed albatross are pelagic wandering species occasionally seen in Alaskan offshore waters, and both spectacled and Steller's eiders seasonally inhabit the Bering Sea, although the former is generally found north of the action area. Polar bears (*Ursus maritimus*) occasionally range in the winter as far south as the Yukon-Kuskokwim Delta (USFWS 1994), but not as far south as the action area (*e.g.,* Kuskokwim Bay) and, therefore, are not addressed in this assessment. None of these species are found in the vicinity of the other Project components including the mine site, pipeline route, access roads, and river barging route; thus, this assessment focuses on only the marine barging routes.

TABLE 2: LISTED MARINE MAMMALS, SEABIRDS, AND SEA DUCKS POTENTIALLY OCCURRING ALONG DONLIN GOLD'S PROPOSED BARGING ROUTES.

Species	Latin Name	ESA Status	Route			
			Pacific Inshore	Pacific Offshore	Bering	Cook Inlet
Northern Sea Otter	*Enhydra lutris kenyoni*	Threatened	X		X	
Pacific Walrus	*Odobenus rosmarus*	Candidate			X	
Marbled Murrelet	*Brachyramphus marmoratus*	Threatened	X			
Short-tailed Albatross	*Phoebastria albatrus*	Endangered		X		
Spectacled Eider	*Somateria fischeri*	Threatened	X		X	
Steller's Eider	*Polysticta stelleri*	Threatened	X		X	

4. STATUS OF LISTED SPECIES

Five ESA-listed species and one candidate species under the jurisdiction of the USFWS have been identified that could potentially occur along the four marine barging routes proposed for the Donlin Gold project (Table 2). The ESA status, biological status, and use of the action area of each are addressed below.

4.1. Northern Sea Otter (*Enhydra lutris kenyoni*)

4.1.1. ESA Status

The Southwest Alaska Distinct Population Segment (DPS) of the northern sea otter was listed as threatened in 2005 after declining an estimated 50 percent (%) since the 1980s. This population stretches from the western shoreline of lower Cook Inlet to the western end of the Aleutian Islands. The entire range of this DPS was designated as critical habitat in 2009 (Figure 2D & 3), and a recovery plan was finalized in 2013.

4.1.2. Biological Status

4.1.2.1. Abundance and Trends

Recovery of the worldwide sea otter population began at the cessation of commercial harvest in 1911. Sea otter populations in the western Aleutian Islands began reaching pre-exploitation levels in the 1940s (Kenyon 1969), and remained at about equilibrium to late in the 20th Century (Estes 1990). However, while otter populations elsewhere continued to increase and reoccupy historical habitat, populations in the Aleutian Islands began to rapidly decline (Estes *et al.* 1998, Doroff *et al.* 2003, Burn and Doroff 2005), resulting in the 2005 listing under ESA. The Southwest Alaska DPS is divided into five management units and the Pacific Inland barging route largely travels through the length of two of them — the Kodiak, Kamishak, Alaska Peninsula and the South Alaska Peninsula management units — and small portions of the Eastern Aleutian and Bristol Bay management units. The South Alaska Peninsula (-74%), Eastern Aleutian (-56%), and Bristol Bay (-39%) management units have all experienced significant population declines since the mid-1980s and early 1990s, while the Kodiak, Kamishak, Alaska Peninsula management unit has remained stable or increased (Bodkin *et al.* 2003; Doroff *et al.* 2003, Burn and Doroff 2005, Estes *et al.* 2005). Overall, including the Western Aleutian management unit, the Southwest Alaska DPS declined between 43% and 58% from approximately between 94,050 and 128,650 animals in 1979 to the most recent estimate of 53,674 (USFWS 2013).

4.1.2.2. Distribution and Habitat Use

Sea otters once occurred in a near continuous distribution from central Baja California north to Alaska, along the Aleutian Islands to the Commander Islands and Kamchatka Peninsula then south to northern Japan (Kenyon 1969). By 1911, when otters were protected under the International Fur Seal Treaty, the world population had been reduced to a few remnant populations, most in Alaska. Sea otters have recovered nearly all their former range in Alaska. The habitat includes nearshore waters inside the 328-foot (ft) (100-meter [m]) isobath, with about 80% use in waters less than 131 ft (40 m) deep (Bodkin and Udevitz 1999). Nearly all their foraging strategy requires diving to the seafloor (Bodkin 2001), and Bodkin *et al.* (2004) found that 84% of the actual foraging occurs in waters less than 98 ft (30 m) deep. Northern sea otters feed over both rocky and soft-sediment ocean floors.

4.1.2.3. Feeding and Prey Selection

Northern sea otters feed on a wide variety of prey (Estes and Bodkin 2002), although the diet is dominated by mollusks, crustaceans, and echinoderms (USFWS 2013). In soft-sediment substrates these otters feed largely on infaunal clam species, while urchins and mussels are more important on rocky substrates. Crabs, snails, and sea cucumbers are also important, but can quickly be overharvested. Green and Brueggeman (1991) found male sea otters inhabiting the north side of the Alaska Peninsula subsisting on nearly a pure diet of 1- to 2-year-old mussels, indicative of an overexploitation of food resources. The diet diversity generally increases over time as abundant prey are consumed and otters are forced to feed on less preferred prey (Estes *et al.* 1981, Estes and Bodkin 2002).

4.1.2.4. Reproduction

Male sea otters become sexually mature at age 3, but generally cannot successfully compete for mating until age 5 or older (Garshelis 1983). Females are sexually mature at the earlier ages of 2 or 3 (Bodkin *et al.* 1993). Copulation and pupping can occur at any time of the year, although there is seasonal synchronicity at some locations (Bodkin and Monson 2002). Gestation, including delayed implantation, is about 6 months, and females usually give birth to a single pup (USFWS 2013). Reproductive rates are relatively high ranging between 80% and 98% (see USFWS 2013).

4.1.2.5. Natural Mortality

Natural mortality in sea otter populations has been difficult to quantify (USFWS 2013). Primary causes of mortality in Alaska include severe winter weather, especially when coupled with low seasonal food supply (Kenyon 1969). Sea ice events on the north side of the Alaska Peninsula have resulted in overland movements of large numbers of otters where they have become susceptible to terrestrial predators. Bald eagles (*Haliaeetus leucocephalus*) are a regular predator of pups (USFWS 2013) and killer whale (*Orcinus orca*) predation was a leading cause of sea otter decline in the Aleutians in the 1990s (Estes *et al.* 1998). Infectious diseases are major sources of mortality in California (Thomas and Cole 1996, Kreuder *et al.* 2003). Sea otter mortality is variable in the first year of life, but annual survival rate is generally high (90%) after that (USFWS 2013). Maximum ages in the wild have been 22 years for females and 15 years for males (USFWS 2013).

4.1.3. Species Use of the Action Area

Although sea otters occur at the western end of the Strait of Juan de Fuca and along the western shoreline of Vancouver Island, none of these otters is likely to be encountered by barging activity given their nearshore range. Sea otters are likely to be first encountered in the inland waters of Southeast Alaska. However, sea otter populations in Southeast and Southcentral Alaska are not listed. The listed Southwest Alaska sea otter stock begins, relative to the Pacific Inland barging route, at Shelikof Strait. However, for much of this route between Kodiak Island the Unimak Pass the barge will follow a deep, central channel away from nearshore otter habitat, except when working through the Shumagin and Pavlov islands, and other small island groups south of the Alaska Peninsula. Otters could also be encountered by the fuel barge entering and exiting Dutch Harbor and Unalaska Bay. There are no sea otters in upper Cook Inlet or anywhere near Kuskokwim Bay.

4.2. Pacific Walrus (*Odobenus rosmarus divergens*)

4.2.1. ESA Status

The Pacific walrus was petitioned for listing in 2008. After a 12-month review ending in 2011, the USFWS concluded that listing was warranted, but precluded by higher priority listing actions. In the interim, the Pacific walrus has been placed on the Candidate species list. The primary reason listing is warranted is the expected effects of declining sea ice on walrus ecology. There is no designated critical habitat for an unlisted species, although important walrus haulout sites in the Bering Sea are protected under state and federal refuge systems. Also, Walrus Protection Areas have been established for the federal waters within 12 nautical mi (22.2 km) of Cape Peirce, The Twins, and Round Island, and proposed for Hagemeister Island (MacLean 2012; Figure 3). Should Pacific walrus become listed, it is likely these protection areas will become designated critical habitat.

4.2.2. Biological Status

4.2.2.1. Abundance and Trends

Fay (1982) estimated that prior to the 19th Century, commercial harvest the Pacific walrus was at a minimum 200,000 animals. To what extent the 19th Century harvest left the population is unknown, but a second wave of commercial harvest in the 20th Century was thought to have reduced the population to between 50,000 and 100,000 animals by the mid-1950s (Fay *et al.* 1997). Once released from harvest, the population increased rapidly and was again at or above carrying capacity by the late 1970s or early 1980s (Fay *et al.* 1989, 1997). Joint Russian-American surveys began in 1975 and were conducted every 5 years until 1990. These surveys produced Pacific walrus population estimates of approximately 200,000 to 300,000, but were based on fall counts at terrestrial haulout sites and a small sample of ice-edge habitat. Also, these estimates were not able to accurately account for animals that were swimming at sea. Due to difficulties in accounting for bias, accurate variances for these population estimates could not be generated, and were presumed to be high (Gilbert *et al.* 1992, Gilbert 1999, Udevitz *et al.* 2001). The estimates could not be used in detecting trends (Gilbert *et al.* 1992, Hills and Gilbert 1994). In 2000, United States (U.S.) and Russian scientists revisited the problems associated with the survey methodologies and began collective research using new technology to identify and reduce bias (Garlich-Miller and Jay 2000). Over the next few years, new study designs and methods were developed and a bilateral survey was again conducted in spring 2006 (Speckman *et al.* 2011). This survey resulted in an estimate of 129,000, albeit with high confidence limits of between 55,000 and 507,000. Also, beset by weather problems, only a portion of the study area was successfully surveyed, leaving the estimate to represent only about half the potential walrus spring habitat (Speckman *et al.* 2011). This, and unknown bias effects to previous surveys, limit the ability to determine if the current Pacific walrus population is increasing, declining, or stable.

4.2.2.2. Distribution and Habitat Use

Seasonal distribution of walrus vary in response to sea ice conditions. During the winter, walrus can range as far south as the Alaska Peninsula, especially during years of extensive sea ice. During summer, they will travel with the ice to the northern reaches of the Chukchi Sea, where the continental shelf gives way to the Arctic Ocean basin. However, the primary distribution is the shelf waters of the Chukchi Sea during the summer and northern Bering Sea during the winter following the advance and retreat of sea ice. During summers, when the ice-edge retreats north in the deep Arctic Ocean basin waters, large numbers of walrus will haulout on Wrangel Island or the Chutkokta coast (Fay 1982).

4.2.2.3. Feeding and Prey Selection

Pacific walrus feed primarily on benthic bivalves, using their muzzles and whiskers to detect prey, and their noses, flippers, and jetted water to extract them from the sediment (Fay 1982). They use mouth suction to remove soft tissue from the shells (Fay 1982). Feeding is not limited to bivalves. Other benthic invertebrates are also consumed, as are occasionally fish and vertebrates, including seals (Fay 1982, Sheffield *et al.* 2001, Sheffield and Grebmeier 2009). Local diet is generally reflective of what is available (Sheffield and Grebmeier 2009), and walrus play a major role in the benthic ecosystem (Garlich-Miller *et al.* 2011).

4.2.2.4. Reproduction

Fay (1982) stated that walrus have the lowest production rate of any pinniped. While females attain sexual maturity at 4 to 7 years of age, males are unlikely to successfully compete or breed until they are about 15 years old (Fay 1982, Garlich-Miller *et al.* 2006). Generally a single calf is produced and is typically nursed for up to two years. Thus, calving intervals can be three years or more (Garlich-Miller and Stewart 1999). Low birth rates are offset by high parental care leading to relatively high first year survival rates (Fay *et al.* 1997). Adult survival is especially high at over 96% for age classes 4 to 20 (DeMaster 1984, Fay *et al.* 1997), declining to zero by about age 40 (Chivers 1999). The maximum population growth rate has been estimated at 8% (Chivers 1999).

4.2.2.5. Natural Mortality

Walrus calves and pregnant females are more susceptible than males to death from trampling and polar bear predation. Fay and Kelly (1980) identified the principal cause of death of several hundred carcasses at coastal haulouts in the Bering Sea to trauma from trampling, during either stampedes or battles between bulls. Early research on walrus found little actual evidence of polar bear predation on walrus other than the potential for predation on calves (Fay 1982). Later research by Calvert and Stirling (1990) found polar bears to be important predators of walruses in the central Canadian High Arctic in late winter and early spring, and predation has been witnessed both on land and ice in the Bering and Chukchi seas (Stirling 2011). Killer whales also prey on walrus (Jefferson *et al.* 1991), especially in the Anadyr Gulf of Russia (Kryukova *et al.* 2012).

4.2.3. Species Use of the Action Area

During the January to March breeding season, walrus breeding aggregations (tens of thousands) form in the ice lee south of Nunivak Island and just west of Kuskokwim Bay (Garlich-Miller *et al.* 2011). However, as the sea ice begins to deteriorate, these walrus migrate north and by May most of the population is concentrated near the Bering Straits (Fay 1982). These wintering and breeding herds do not temporally overlap with barging activity to and from Bethel. However, a few thousand walrus, mostly males, remain all summer in the Bering Sea (Garlich-Miller *et al.* 2011). Most of these summering males haulout just south of Kuskokwim Bay at Cape Newenham, Cape Peirce, and Round Island, and at Cape Seniavin on the north side of the Alaska Peninsula (Garlich-Miller *et al.* 2011). Lesser used haulout sites include Hagemeister, Crooked, Twin, and Amak islands, and Cape Constantine. Cape Newenham is about 30 mi

(48 km) east of the proposed barging route into Kuskokwim Bay, while Cape Peirce is approximately 50 mi (80 km) away and Round Island 115 mi (185 km). Amak Island is 60 mi (97 km) east of the barging route coming out of Unimak Pass or Dutch Harbor. Jay and Hills (2005) satellite-tagged 59 adult male walrus at Cape Seniavin, Cape Peirce, Cape Newenham, and Round Island and found that these animals forage primarily inside Bristol Bay (southward of the haulout sites) during May through August. Kuskokwim Bay became an important foraging area September through December, especially during October. Based on these study results, a few foraging walrus might be encountered during summer barging immediately west of Cape Newenham, and within Kuskokwim Bay during September. However, Bering Sea barging routes largely bypass walrus summer haulout and foraging areas, and are well outside the established Bristol Bay Walrus Protection Zones (Figure 3).

4.3. Marbled Murrelet (*Brachyramphus marmoratus*)

4.3.1. ESA Status

The marbled murrelet populations in Washington, Oregon, and California were listed as threatened under the ESA in 1992 after harvest of old-growth forests had dramatically reduced their nesting habitat. Critical habitat was designated in 1996, and revised in 2011. None of the critical habitat includes marine waters. The marbled murrelet was also listed as threatened in British Columbia by the Committee on the Status of Endangered Wildlife in 1990 and confirmed in 2000, and is on the Species at Risk Act list. Populations in Alaska are not listed.

4.3.2. Biological Status

4.3.2.1. Abundance and Trends

The 2010 population of marbled murrelets occurring in Washington, Oregon, and California is currently estimated at 16,700, and continues to decline at an annual rate of about 3.7% (Washington Department of Fish and Wildlife [WDFW] 2014). The portion of the population that inhabits the inland waters of Washington was estimated in 2010 at 4,393 birds, and from 2001 to 2010 declined at an annual rate of 7.4% (WDFW 2014). The British Columbia population is estimated at 54,000 to 92,000 birds and the Alaskan population at about 270,000 (Piatt *et al.* 2006a). Both populations appear to be declining.

4.3.2.2. Distribution and Habitat Use

Marbled murrelets occur almost continuously in nearshore marine waters from central California to the Aleutian Islands. The highest at-sea densities of marbled murrelets in Washington are found along the southern end of Lopez Island (San Juan Islands) and along the coastal shoreline near Port Angeles, with moderate densities at Indian Island adjacent to Admiralty Inlet and east of Clallam Bay. All of these locations are adjacent to proposed barge travel routes through Admiralty Inlet, Rosario Strait, and the Strait of Juan de Fuca. Their at-sea distribution, in general, is limited to within 1.2 mi (1.9 km) of the shore, while murrelets will travel as far as 50 mi (80 km) inland to nest in old-growth conifer trees (USFWS 1997). Critical habitat designated by the USFWS reflects where nesting is currently known to occur. There is no critical habitat in marine waters.

4.3.2.3. Feeding and Prey Selection

Pacific sand lance (*Ammodytes hexapterus*) is the most important prey item across the marbled murrelets range, although Pacific herring (*Clupea harengus*), northern anchovy (*Engraulis mordax*), and smelts are also important to Pacific Northwest birds (USFWS 1997). Prey preference has been determined by noting what species are carried in their bills to feed nestlings. It is not clear that the adult diet for Pacific Northwest birds is entirely similar to what they feed chicks. Most birds forage in waters shallower than 328 ft (100 m), and are capable of diving to at least 89 ft (27 m) (Carter and Erickson 1992). Given the energy these birds expend on long-distance trips between nests and foraging areas, it is important that forage fish are abundant and easily caught in order for murrelets to balance their energetic demands.

4.3.2.4. Reproduction

Marbled murrelets nest on large, moss-covered limbs of inland old-growth conifer trees. Breeding is asynchronous with egg laying as early as March and as late as August (Hamer and Nelson 1995). Only one egg is laid, and it is unclear if they will renest after failure (Nelson 1997). Incubation lasts 28 to 30 days, and chicks fledge 28 to 40 days after hatching (Simons 1980, Hirsch *et al.* 1981). Reported overall nesting success is only 28% (Nelson and Hamer 1995), with failure largely due to predation on eggs and nestlings. Adult annual survival has been estimated at 81% to 88% and for first-year birds about 70% (Beissinger 1995).

4.3.2.5. Natural Mortality

Marbled murrelets nest in forests that support an abundance of potential predators on eggs and chicks (Nelson and Hamer 1995, Piatt *et al*. 2006a). Known predators of eggs and chicks include ravens (*Corvus corax*), jays, and great horned owls (*Bubo virginianus*) (Nelson and Hamer 1995). Predation is a major cause of nest failure (Nelson and Hamer 1995). Forest hawks (*Accipiter* spp.) reportedly have preyed on adult murrelets (Marks and Naslund 1994, USFWS 1997), and peregrine falcons (*Falco peregrinus*) and bald eagles have been observed to prey on adults in the marine environment (Vermeer *et al*. 1989, Piatt *et al*. 2006a).

4.3.3. Species Use of the Action Area

Proposed Donlin Gold barging routes in Washington pass by marbled murrelet high-density areas in Admiralty Inlet, Rosario Strait, and the Strait of Juan de Fuca. However, marbled murrelets generally remain near shore and don’t venture often into the deeper shipping channels. Much of the marbled murrelet population in British Columbia occurs along the outer coast of Vancouver Island and the Queen Charlotte Islands, well away from the proposed Pacific barging routes. However, barging will occur through the Princess Royal Channel, where large numbers of murrelets have been recorded (Burger 2002)

4.4. Short-tailed Albatross (*Phoebastria albatrus*)

4.4.1. ESA Status

The short-tailed albatross was listed as endangered throughout its range in 2000. Prior to the turn of the 20th Century, millions of these birds had been harvested for their feathers bringing the species to near extinction by the mid-20th century (USFWS 2008). One island alone, Torishima, supported at least 300,000 breeding pairs prior to exploitation. By 1949 there were no breeding pairs remaining on any of the 14 islands of Japan and Taiwan where they previously nested, and the species was thought to have gone extinct (Austin 1949). However, soon after this declaration, a few birds that presumably had been wandering the North Pacific during the final years of slaughter began returning to Torishima Island where eventually they formed two breeding colonies. Breeding pairs began appearing at Minami Kojima Island in the Senkaku Islands group in the early 1970s (USFWS 2008).

4.4.2. Biological Status

4.4.2.1. Abundance and Trends

The worldwide short-tailed albatross population has grown steady since reestablishing breeding in the early 1950s. The 2007-2008 estimated population for breeding birds was 1,114, and the subadult population estimated at 1,292, or 2,406 (USFWS 2008). More than 82% of the population originated from Torishima, where the colony has been growing at an annual rate of 6.5% to 8.0% (USFWS 2008).

4.4.2.2. Distribution and Habitat Use

Short-tailed albatross originally nested at 14 islands offshore of Japan and Korea, but currently only nest on the Japanese-managed island of Torishima, and Minami Kojima Island located about 110 mi (177 km) northeast of Taiwan, where its ownership is under dispute by Taiwan, China, and Japan (USFWS 2008). Efforts are undergoing to establish colonies elsewhere. During the four-month non-breeding season, male adult short-tailed albatross largely travel to feeding waters of the Bering Sea and Aleutian Islands, while females are more likely to feed in Japanese and Russian waters (Suryan *et al.* 2007a). Juveniles and subadults, however, range a far wider area of the North Pacific, including down the U.S. west coast, before returning to their breeding colony of origin at 5 to 6 years of age.

Foraging short-tailed albatross spend most of their time in shelf waters less than 3,281 ft (1,000 m) deep, and rarely in waters deeper than 9,843 ft (3,000 m) outside Japan (Suryan *et al.* 2007b, USFWS 2008). These birds concentrate in upwelling areas off Japan, along the shelfbreaks of the Aleutian Islands and the Gulf of Alaska, and along the edge of the Bering Sea shelf (Suryan *et al.* 2006, Piatt *et al.* 2006b). Juveniles and subadults off the United States west coast also spend most their time near the continental shelf edge, while birds that have been satellite-tracked in deeper pelagic waters appear to be transiting between foraging areas (Suryan *et al.* 2007b).

These birds were once thought to be coastal because of their prevalence in Native midden sites from southern California to St. Lawrence Island (Murie 1959, Piatt *et al.* 2006b). However, Piatt *et al.* (2006b) has shown that these birds concentrate at the shelf edge and over submarine canyons, and aboriginal hunting would likely have occurred as they birds moved through the Aleutian passes and where “hotspot” upwelling sites are close enough the coast to have been reached by boat-based Native hunters.

4.4.2.3. Feeding and Prey Selection

Short-tailed albatross feed largely on squid, shrimp, and schooling fish (Hasegawa and DeGange 1982), and fish offal discarded from fishing vessels (Melvin *et al.* 2001). These birds feed on squid more than other species of albatross (USFWS 2008). Piatt *et al.* (2006b) found that in Alaska, short-tailed albatross are concentrated along the shelf edges from the Gulf of Alaska through the Aleutians, and particularly along the edge of the Bering Sea shelf where upwelling brings squid to the surface, making them available to the shallow-diving albatross.

4.4.2.4. Reproduction

Short-tailed albatross are slow reproducing birds that can live to 40 years of age (USFWS 2011). They begin breeding at about age 5 or 6, and lay a single egg. Slow-growing chicks are dependent on their parents until fledging at about 5 months. In all, the breeding season lasts about 8 months.

4.4.2.5. Natural Mortality

Apparently crows (*Corvus macrorhynchos*) preyed heavily on albatross chicks at Torishima prior to 1949 (Austin 1949), but are not present on the island today (USFWS 2008). Sharks and Steller's sea eagles (*Haliaeetus pelagicus*) may occasionally take fledglings, but adult short-tailed albatross have few natural threats to survival. Monsoon rains have destroyed nesting habitat leading to chick mortality, and because Torishima is an active volcano, an eruption could have a catastrophic impact to the world population (USFWS 2008).

4.4.3. Species Use of the Action Area

More than 1,300 sighting records from Alaskan waters clearly show that short-tailed albatross concentrate along the Aleutian Islands, Bering Sea, and Gulf of Alaska shelf edges. The Pacific Offshore barging route briefly crosses shelf edge habitat before entering Unimak Pass, as does the Bering Sea route coming out of Dutch Harbor. Unimak Pass may also be a pathway for albatross moving between Bering Sea and Pacific habitats, although sighting records suggest that farther west Aleutian passes may be much more important.

4.5. Spectacled Eider (*Somateria fischeri*)

4.5.1. ESA Status

The spectacled eider was listed as threatened under the ESA in 1993 after the Yukon-Kuskokwim Delta breeding population declined from about 48,000 in the 1970s to only about 2,000 in the early 1990s (Stehn *et al.* 1993, Ely *et al.* 1994). Reasons for the decline are unknown, but appear to be related to adult mortality outside the breeding season (Flint *et al.* 2000), and may relate to ingestion of toxic lead shot (Grand *et al.* 1998). Critical habitat, targeting protection of Yukon-Kuskokwim Delta breeding habitat (Figure 3) and molting habitat in Ledyard Bay and Norton Sound, was designated in 2001. A recovery plan was finalized in 1996.

4.5.2. Biological Status

4.5.2.1. Abundance and Trends

The range-wide spectacled eider population appears to have remained stable or increased slightly in recent years. Petersen *et al.* (1999) estimated the 1997 population at 363,000, while Larned *et al.* (2012) estimated the 2010 wintering population at 369,122. However, significant declines have occurred in Alaska at least. The Yukon-Kuskokwim Delta breeding population used to be larger than the Russian and northern Alaska population combined with an estimated 48,000 to 70,000 pairs annually breeding there prior to 1972 (Dau and Kistchinski 1977). By 1992, however, only an estimated 2,000 pairs remained (Stehn *et al.* 1993). Since then the Yukon-Kuskokwim Delta breeding population has grown at an annual rate of about 7%, and the number of breeding birds exceeded 12,000 by 2010 (Platte and Stehn 2011).

Breeding population estimates are unavailable for the North Slope before 1992 other than Warnock and Troy (1992) who documented an 80% decline in nesting in the Prudhoe Bay area between 1981 and 1991. Stehn *et al.* (2006) used data collected from 2002 to 2006 to estimate the 2006 North Slope breeding population at 13,000 birds. From data collected by Larned *et al.* (2011) between 2007 and 2010, the estimate was less at about 11,000.

4.5.2.2. Distribution and Habitat Use

Spectacled eiders breed in coastal habitats at three locations in arctic Russia, and on the North Slope and the Yukon-Kuskokwim Delta in Alaska, usually arriving in May (Johnson and Herter 1989). During late May and June, Alaskan males leave the breeding grounds and concentrate at molting areas in Ledyard Bay and Norton Sound (Petersen *et al.* 1995). Successful females and juveniles arrive at these molting areas in September. The range-wide population winters in the polynyas that form south of St. Lawrence Island (Petersen *et al.* 1999) in an area of only about 1,500 mi^2 (3,885 km^2).

4.5.2.3. Feeding and Prey Selection

Spectacled eider diet during the breeding season is composed largely of freshwater flies, shrimp, snails, and pondweeds (Petersen *et al.* 2000). In marine molting and wintering areas, these eiders eat primarily snails, clams, mussels, amphipods, and juvenile crabs (Petersen *et al.* 2003), although Macoma clams were the dominant food occurring in 72% of the samples (Petersen *et al.* 1998). Spectacled eiders were found to forage for this prey at depths between 150 and 230 ft (45 and 70 m) (Petersen *et al.* 1998).

4.5.2.4. Reproduction

Spectacled eiders prefer to nest on islands and peninsulas or along pond shorelines (Petersen *et al.* 2000) where escape to protective water is nearby. Clutch size can vary from 1 to 11, with the average size 5 eggs on the Yukon-Kuskokwim Delta and 3.5 eggs for the North Slope (Petersen *et al.* 2000). The incubation period is 24 days, and chicks fledge at 45 to 50 days (Petersen *et al.* 2000). Hens will occasionally re-nest if the first nest is lost.

About half the females nest in their second year, and generally nest for 5 consecutive years. Nesting success varies greatly depending on predator densities and weather conditions and ranged on the Yukon-Kuskokwim Delta from 12% to 78% (Grand and Flint 1997). Flint and Grand (1997) studied spectacled eider reproduction on the Yukon-Kuskokwim Delta and found that over the first 30 days of life, duckling survival was only 34%, but increased to 71% for the next 30 days. Grand *et al.* (1998) found that the adult females not exposed to lead shot contamination had a higher annual survival rate (78%) than those that were exposed (44%).

4.5.2.5. Natural Mortality

The primary nest predators are gulls (*Larus* spp.), jaegers (*Stercorarius* spp.), foxes (red [*Vulpes vulpes*] and arctic [*Vulpes lagopus*]), and mink (*Mustela vision*), depending on the nesting area. Foxes and mink will also prey on nesting adults. These predators may have recently increased on the North Slope in response to increased human development (Day 1998). There is no information on natural mortality at sea. Storm tides can destroy nests and drown hatchlings (Petersen *et al.* 2000).

4.5.3. Species Use of the Action Area

None of Donlin Gold's barging routes intersect breeding, molting, or wintering habitat used by spectacled eiders. However, the South Yukon-Kuskokwim Delta critical habitat breeding area is located immediately north of Kuskokwim Bay (approximately 80 mi [129 km] north of the actual Bering Sea barging route) and could be affected by an oil spill event inside Kuskokwim Bay given the prevailing northward flow of the West Alaska Current (the Bering Sea extension of the Alaska Coastal Current).

4.6. Steller's Eider (*Polysticta stelleri*)

4.6.1. ESA Status

Steller's eider is a small, bottom-foraging diving duck with breeding populations in Russia and the U.S. Because of significant population declines, the U.S. breeding population was listed as threatened in 1997, and critical habitat was designated in 2001, with the Kuskokwim Shoals unit the nearest critical habitat to the proposed barging routes (Figure 3). A recovery plan was finalized in 2002.

4.6.2. Biological Status

4.6.2.1. Abundance and Trend

While the Russian Pacific population of the Steller's eider numbers between 50,000 and 100,000, the U.S. breeding population may number only about 500 (USFWS 2001). The Alaska breeding population experienced a significant decline in the late 20th Century (Quakenbush *et al.* 1999); low breeding density and great interannual variation in breeding locations make it difficult to determine whether the population is beginning to stabilize or increase.

4.6.2.2. Distribution and Habitat Use

Steller's eiders arrive on their Siberian and Alaskan breeding grounds in late May and early June. In Alaska, breeding is confined to the Arctic Plain, with concentrations near Barrow, although nowhere is it common (Quakenbush *et al.* 2002). These eiders also once nested on the Yukon-Kuskokwim Delta, but no significant breeding activity has been observed there for several decades (Kertell 1991, Flint and Herzog 1999). A historical breeding record (Dall 1873) from Unalaska Island is unsubstantiated, and there are no recent summer records for this location (Quakenbush *et al.* 2002). Males begin leaving the breeding grounds in early July, arriving at Southwest Alaska molting areas. Females remain on breeding grounds until broods have fledged, then migrate to molting areas or directly to wintering grounds farther south. Most Pacific populations of eiders molt within the lagoons along the Alaska Peninsula, especially Nelson and Izembek lagoons (Petersen 1981), although small numbers molt along the nearshore waters throughout Bristol Bay, including northern Kuskokwim Bay where about 5,000 birds have been found (Larned and Tiplady 1996, Wilson *et al.* 2012). Based on limited satellite tracking data, Kuskokwim Shoals may be especially important for Alaska breeders (Rosenberg *et al.* 2011).

During the fall, U.S. Steller's eider populations are joined by thousands of unlisted Russian Steller's eiders along the north side of the Alaska Peninsula, where they undergo several weeks of molt (Jones 1965, Ward and Stehn 1989, Laubhan and Metzner 1999). In late November they begin moving to overwintering areas in the Aleutian Islands, the south side of the Alaska Peninsula, Kodiak Archipelago, and Cook Inlet (Petersen 1981, USFWS 2002). A number of these birds overwinter in Unalaska Bay (Quakenbush *et al.* 2002). During April and May, nearly the entire population wintering in Alaska concentrates in Bristol and Kuskokwim bays as they wait for the sea ice to retreat and breeding ponds to thaw (USFWS 2001).

4.6.2.3. Feeding and Prey Selection

Steller's eiders are reported to consume a diverse diet of invertebrates, suggesting they are nonselective foragers (Petersen 1980; 1981; Metzner 1993; Bustnes and Systad 2001) whose main diet consists of bivalves, gastropods, and crustaceans such as crabs, shrimp, and amphipods (Vang Hirsh 1980, Goudie and Ankney 1986, Metzner 1993, Ouellet *et al.* 2013). Goudie and Ankney (1986) suggested that small ducks wintering in northern latitudes, such as Steller's eiders, do so at the edge of their energetic limits.

4.6.2.4. Reproduction

Steller's eiders begin courtship and pairing in April often while still on the spring staging grounds (Fredrickson 2001). Nest-building begins within days of arriving on the nesting grounds, with egg-laying occurring mid-June (Quakenbush and Cochrane 1993). Clutches average about 6 eggs, which hatch 26 to 27 days after laying the first egg (Fredrickson 2001). There are no re-nesting opportunities in the short Arctic summer. In Russia, successful females and fledglings leave the nesting grounds in late August to mid-September (Solovieva 1997). Nesting success is highly variable in Alaska, and appears related to the number of lemmings, an alternative prey for local nest predators (Quakenbush and Suydam 1999).

4.6.2.5. Natural Mortality

Maximum longevity is more than 20 years, and there is little information on major causes of adult mortality (Fredrickson 2001), although in Alaska, jaegers and common ravens have been identified as egg predators (Quakenbush and Suydam 1999). Presumably, red (*Vulpes vulpes*) and arctic (*V. lagopus*) foxes are potential predators of both nests and nesting adults.

4.6.3. Species Use of the Action Area

The Pacific Inshore route passes by waters used by lesser concentrations of wintering Steller's eiders, especially along the south side of the Alaska Peninsula. However, barging will not occur during the November to April wintering period, thus there is no temporal overlap with barging and wintering eiders. Four Bering Sea areas important to spring staging and fall molting are designated critical habitat. These include Izembek Lagoon, Nelson Lagoon, Seal Islands, and Kuskokwim Shoals (Figure 3). All of these areas are used by Steller's eiders for spring staging during the early barging season (May) and as molting during the late barging season (August and September). However, neither Bering Sea barging route (from either Unimak Pass or Dutch Harbor) intersect designated critical habitat, although barging through Kuskokwim Bay passes within about 50 mi (80 km) of the 1,472 mi^2 (3,813 km^2) Kuskokwim Shoals critical habitat annually used by about 5,000 birds.

5. CONSEQUENCES OF PROPOSED ACTION

Two activities proposed by Donlin Gold project's construction and operation have the potential to impact wildlife species under the jurisdiction of the USFWS: Supply barging between Seattle and Bethel and fuel barging between Dutch Harbor and Bethel. Potential effects include disturbance from noise generated by the tug propellers, an accidental oil or chemical spill from an at-sea accident including collision with other vessels or grounding, and incidental fuel spills (*e.g.,* fuel transfer) contributing to impaired harbor waters. Vessel strike is not considered a risk for any of the species addressed in this assessment given the animals' ability to maneuver and the slow speeds of the barges (<10 knots [kt] [18.5 km/hour [hr]]), and is not addressed further. The other three potential stressors are addressed below.

5.1. Disturbance

Disturbance concerns include visual disturbance at important wildlife concentration areas, such as sea duck molting areas and walrus haulouts, and underwater noise disturbance produced by the tug. However, as the tug/barge will follow established travel lanes and will not approach walrus haulout sites or nearshore habitats used by sea otters, marbled murrelets, and molting Steller's eiders, potential disturbance is limited. Both sea otters and Steller's eiders would likely be encountered during fuel barge passage in and out of Dutch Harbor and Iliuliuk Bay, but these animals would be well conditioned to boat and ship traffic given the normal summer fishing activity at Dutch Harbor. Visual disturbance to short-tailed albatross and spectacled eiders is of little concern given the small likelihood of encounter based on rarity of these species in the travel corridors during the summer months.

Apart from any potential for damaging marine mammal hearing, loud vessels can disrupt normal behaviors of marine mammals either through auditory or visual harassment. Disturbed animals may quit feeding, move away from feeding areas, display overt reactions, or display other behaviors that expend undue energy potentially culminating in lowered fitness.

Relative to marine mammals, man-made noise introduced into the marine environment can result in impaired hearing, disturbance of normal behaviors (*e.g.,* feeding, resting, social interactions), mask calls from other species members, disrupt echolocation capabilities, and mask sounds generated by approaching predators. Behavioral effects may be incurred at ranges of many miles, and hearing impairment may occur at close range (Madsen *et al.* 2006). Behavioral reactions may include avoidance of, or flight from, the sound source and its immediate surroundings, disruption of feeding behavior, interruption of vocal activity, and modification of vocal patterns (Watkins and Scheville 1975, Malme *et al.* 1984, Bowles *et al.* 1994, Mate *et al.* 1994). Long-term exposure can lead to fitness-reducing stress levels, and in some cases physical damage leading to death can occur (*e.g.,* Balcomb and Claridge 2001).

Most pinnipeds have peak sensitivities between 1 and 20 kilohertz (kHz) (National Research Council 2003), with phocids such as ringed and harbor seals peaking at over 10 kHz and showing good sensitivity to approximately 30 kHz (Wartzok and Ketten 1999). Relative to other pinnipeds, however, Pacific walrus are sensitive to lower frequency underwater sounds. Kastelein *et al.* (2002) found maximum walrus sensitivity at 12 kHz with best sensitivity between 1 and 12 kHz. Unlike other pinnipeds, walrus hearing sensitivity drops sharply beyond 12 kHz. Also, Kastelein *et al.* (1996) found in-air walrus hearing to be less sensitive than that of sea lions and harbor seals.

Underwater hearing ability of sea otters is significantly less than that of pinnipeds (Ghoul and Reichmuth 2014). Their ear structure suggests that there has been little change since their terrestrial origin. Unlike other marine mammals, the sea otter ear canal remains fully open and not closed as in cetaceans or reduced as in pinnipeds. Their one adaption appears to be an earflap that closes over the ear canal during diving, trapping air inside. While this mechanism would protect the inner ear, an ear canal filled with air can cause an impedance mismatch reducing sound conduction to the middle and inner ears (Wartzok and Ketten 1999). Ghoul and Reichmuth (2014) found sea otters have poor hearing sensitivity below 1 kHz, and best sensitivity between 2 and 26 kHz, but the lowest threshold (69 dB re 1 μPa at between 8 and 16 kHz) was much higher than pinnipeds. In sum, sea otters do not appear to be particularly adapted to hearing underwater sounds, which is supported by the lack of evidence of underwater communication (Ghoul and Reichmuth 2012). Sea otters do communicate above water, especially with loud screams between separated mothers and pups (McShane *et al*. 1995). Ghoul and Reichmuth (2012) measured these vocalizations and found that the intensity of these calls ranged between 50 and 113 decibels with sound pressure level referenced at 20 micropascals (dB SPL re 20 μPa), and were loud enough that they can be heard by humans at distances exceeding 0.62 mi (1 km) (McShane *et al*. 1995). Aerial hearing in sea otters is similar to terrestrial carnivores with best sensitivity between 1.2 and 27 kHz (Ghoul and Reichmuth 2014).

Disturbance thresholds from impulsive underwater noise has been established for marbled murrelets and has been used to assess potential seismic and pile driving effects on Steller's eiders. However, noise generated by the barging operation is continuous, and there are no continuous noise criteria for birds.

5.1.1. Threshold Shift

When exposed to intense sounds, the mammalian ear will protect itself by decreasing its level of sensitivity (shifting the threshold) to these sounds. Stereocilia are the sound sensing organelles of the middle and inner ear. They are the "hairs" of the specialized cells that convert sound wave energy to electrical signals. When sound intensity is low, the hairs will bend towards the incoming waves, thereby increasing sensitivity. If the sound intensity is high, the hairs will bend away in an effort to reduce wave energy damage to the sensitive organelles, which includes a reduction in sensitivity. If the sound levels are loud enough to damage the hairs, the reduction in sensitivity will remain, resulting in a shift in hearing threshold. These threshold shifts can be temporary (temporary threshold shift [TTS]) or permanent (permanent threshold shift [PTS]) (Weilgart 2007) depending on the recovery ability of the stereocilia and connecting hair cells. Over-activation of hair cells can lead to fatigue or damage that remains until cells are repaired or replaced.

Exposure to intense impulsive noises can disrupt and damage hearing mechanisms, leading to a threshold shift. However, these threshold shifts are generally temporary (TTS), as the hair cells have some ability to recover between and after the intermittent sound pulses. Long-term exposure to continuous noise, even noise of moderate intensity, can lead to a PTS. This is because the continuous wave energy does not allow hair cells to recover. If the exposure is long enough, the ability to replace damaged hair cells after the exposure has ceased is also reduced, and the threshold shift becomes permanent.

Anthropogenic sources of underwater impulsive noises that could lead to TTS include seismic surveys, pile driving, and blasting. However, Donlin Gold's barging operation will not produce impulsive noises, so these TTS concerns do not apply. The primary underwater noise associated with the proposed barging operations is the continuous cavitation noise produced from the twin-screw propeller arrangement on the oceanic tugboats, especially when pushing or towing a loaded barge. Other noise sources include onboard diesel generators and the firing rate of the main engine, but both are subordinate to the blade rate harmonics (Gray and Greeley 1980). These continuous sounds for small ships have been measured at up to 171 decibels referenced at 1 micropascal in meters (root mean square) (dB re 1 μPa-m (rms)) at 1-m source (broadband), and they are emitted at dominant frequencies of less than 5 kHz, and generally less than 1 kHz (Miles *et al.* 1987, Richardson *et al.* 1995, Simmonds *et al.* 2004). Measured cavitation noise from modern cargo ships have peak energies less than 100 Hz (Areveson and Vendittis 2000, McKenna *et al.* 2012), resulting from both the blade rate harmonics and the chaotic collapse of cavities (cavitation), with a rapid drop off of about 6 dB per octave on a constant-bandwith plot (Areveson and Vendittis 2000). Cavitation noise is a potential source for PTS depending on the received noise level (a function of the distance the animal is to the vessel) and duration (dependent on the period animal and vessel are in proximity). There is some overlap between the hearing in walrus and sea otters and cavitation noise, as the best underwater hearing sensitivity for walrus is between 1 to 12 kHz (Kastelein *et al.* 2002) and for sea otters is between 2 and 26 kHz (Ghoul and Reichmuth 2014). However, peak cavitation frequencies (<100 Hz) do not overlap with peak hearing sensitivities (>1 kHz) thereby reducing PTS risk. More importantly, walrus and sea otter exposure to continuous tug noise is limited to the dive duration. The average dive time of a northern sea otter has been measured at only 85 seconds (Bodkin *et al.* 2004) to 149 seconds (Wolt *et al.* 2007), far too short a period for the onset of PTS. Walrus dive times are longer (5 to 10 minutes; USFWS 2009), but still well short of PTS impacts. Thus, hearing loss in walrus and sea otters is not of concern from the proposed oceanic barging operations.

No data currently exists on the physiological effect of anthropogenic noise on seabirds and, like sea otters and walrus, the exposure duration (limited to the short dive period) from the moving vessels is far too short to induce PTS regardless. (The FWS has adopted impulsive underwater noise injury criteria for marbled murrelets, but no criteria has been developed for continuous noise.) New research by Therrien (2014) suggests that ducks hear best underwater at low frequencies between 0.5 and 2.86 kHz, or at frequencies similar to cavitation noise and, therefore, might be susceptible to masking. However, other research to date has failed to show significant seabird response to even loud seismic noises (Stemp 1985, Turnpenny and Nedwell 1994). Further, dive durations for albatross, murrelets, and eiders are generally a minute or less (Strachan *et al.* 1995, Heath *et al.* 2007, Evers *et al.* 2010) with longer rest periods between dives. Noise exposure is limited to when a dive event coincides to the short time a travel vessel is in effective hearing range.

5.1.2. Masking

Masking occurs when louder noises interfere with marine mammal vocalizations or their ability to hear natural sounds in their environment (Richardson *et al.* 1995), which limit their ability to communicate or avoid predation or other natural hazards. Masking is of particular concern with baleen whales because low-frequency anthropogenic noises overlap with their communication frequencies, but less so for pinnipeds. Pinnipeds in general hear well in noisy backgrounds (Southall *et al.* 2000), probably as an adaption to hearing when exposed to surf and other wave noise. Pacific walrus males produce loud underwater "songs" during the winter breeding season (Fay 1982, Schusterman and Reichmuth 2008), but apparently not at other times of the year, and there is no evidence of females or calves vocalizing underwater (Schusterman and Reichmuth 2008). Any communication or masking concerns would, therefore, be limited to outside the barging season. None of the other animals addressed in this assessment are known to communicate underwater.

Masking can prevent marine animals from hearing approaching predators. However, predation is not a primary mortality factor for summering male walrus or diving seabirds. Also, underwater noise would not contribute to increased sea otter mortality from an aerial predator such as a bald eagle, although it might for an underwater predator such as a killer whale. Still, sea otters spend the great majority of their time with their head out of the water and are likely to use visual cues more than auditory to detect approaching killer whales.

5.1.3. Chronic Disturbance

Continued exposure to low levels of noise and disturbance can lead to chronic stress, potentially further leading to stress-related responses such as immune system suppression, reproductive failure, slowed growth, and an overall decline in fitness. Chronic stress is exposure to stressors that last for days or longer, and does not apply to a passing barge. However, disturbance noise from a passing barge (acute stress) can add to the overall stress budget (known as the allostatic load; Romero *et al.* 2009) of an individual marine mammal contributing to a general distress and deleterious effects. Additional barging (multiple passes) would, of course, contribute further to the stress load.

Donlin Gold's planned barging has some additive effect to the overall anthropogenic noise budget. Donlin Gold plans 12 cargo barging round-trips (24 transits) annually from Seattle to Bethel. These transits represent 0.2% of the nearly 11,000 annual large commercial and passenger ship, tanker, and barging transits occurring within Puget Sound and the Strait of Juan de Fuca (Washington State Department of Ecology 2014), and 0.5% of the 4,500 commercial vessels that annually pass through Unimak Pass (Transportation Research Board [TRB] 2008). The extent of the existing budget of shipping noise in Puget Sound was further demonstrated by Bassett *et al.* (2012), who found that nearly four commercial vessels of over 300 gross tons passed daily through the narrow Admiralty Inlet, and for over 90% of the time, at least one vessel was detectible by hydrophones.

Most information on the reaction of pinnipeds to boats relates to disturbance of hauled out animals. None of the proposed barging routes will come within disturbance distance to walrus haulouts. There is little information on the reaction of pinnipeds to ships while in the water other than some anecdotal information that sea lions are often attracted to boats (Richardson *et al*. 1995).

5.1.4. Relevance to Donlin Gold Barging

Donlin Gold's proposed oceanic barging program will contribute to existing vessel traffic noise along all four barging routes. At times, the tugboat/barge may temporarily disturb marine wildlife, resulting in acute stress levels and adding to the animal's overall stress budget. However, the overall effect is probably minimal given that the Donlin Gold's barging traffic would be well less than 1% of the total vessel traffic in the region, and by traveling at a normal speed of less than 10 kt (18.5 km/hr), the individual noise source contribution is relatively less than other commercial vessels. Further, the propellers on ocean tugboats are generally recessed under the vessel hull to reduce cavitation and protect the nozzled propellers from damage during a grounding event. As a result, much of the noise emanating from the propellers is blocked (acoustical shadow) by the tugboat's hull, especially forward of the tug. Moreover, the nozzles themselves reduce cavitation, thereby further reducing noise levels to some degree. Overall, Donlin Gold's barging program is unlikely to result in undue disturbance and stress increase in listed marine wildlife.

5.2. Accidental Spill

A barge related oil spill would potentially be a large spill (hundreds to millions of gallons) involving the rupture of a vessel or transported fuel tank, usually as a result of a collision, sinking, fire, or running aground. Oil effects to marine wildlife that could result include skin contact with the oil, ingestion of oil, respiratory distress from hydrocarbon vapors, contaminated food sources, fouled feathers and fur, and displacement from feeding areas (Geraci 1990). Actual impacts would depend on the extent and duration of contact, and the characteristics (age) of the oil. Most likely, the effects of oil would be irritation to the respiratory membranes and absorption of hydrocarbons into the bloodstream (Geraci 1990). If a marine animal was present in the immediate area of fresh oil, it is possible that it could inhale enough vapors to affect its health. Inhalation of petroleum vapors can cause pneumonia in humans and animals due to large amounts of foreign material (vapors) entering the lungs (Lipscomb *et al.* 1994). Contaminated food sources and displacement from feeding areas also may occur as a result of an oil spill. Long-term ingestion of pollutants, including oil residues, could affect reproductive success, but data is lacking to determine how oil may fit into this scheme for marine wildlife. Seabirds and sea otters are so dependent on the insulative value of their feathers and fur that even a small amount of fouling can lead to death (Levy 1980, Burger and Fry 1993, O'Hara and Morandin 2010). In fact, it is generally accepted that feather fouling is the primary cause of mortality to seabirds in an oil spill event (Leighton 1991), and the *Exxon Valdez* spill in 1989 was thought to have killed nearly 4,000 sea otters in Prince William Sound (DeGange *et al.* 1994).

Major oil spills have occurred in recent decades from vessels initially following routes similar to the Pacific routes proposed by Donlin Gold. Between 1981 and 2005, at least 26 oils spills of greater than 1,000 gallons occurred in the Aleutians, mostly from fishing vessels (16), although two large spills were from tank barges (TRB 2008). The four largest were:

- The Tank Barge 283 ran aground in 1988 on the Shumagin Islands releasing more than 2,000,000 gallons of diesel fuel.
- The M/V Selendang Ayu lost power and ran aground on the north shore of Unalaska Island in 2004, eventually breaking up and resulting in 336,000 gallons of heavy fuel oil spilled.
- The M/V Kuroshima dragged anchor in Dutch Harbor during a severe storm in 1997, resulting in loss of 40,000 gallons of heavy fuel oil.
- T/B Foss 256 was offloading fuel oil cargo at Amchitka Island in 1989 when severe weather pushed the barge over rocks. Several fuel tanks were penetrated spilling 84,000 gallons of diesel fuel.

Further, the remoteness of the barging routes may make it difficult for a quick oil spill response. The longer the oil remains in the marine environment the harder it becomes to collect it. Little of the oil from the aforementioned spills was ever cleaned up.

The risk and effects of a potential chemical spill has not been previously assessed. Information on the chemicals to be transported and the risk of a spill are found in Section 6.1.2.

5.2.1. Relevance to Donlin Gold Barging

Each fuel barge launching from Dutch Harbor has the capacity to carry nearly 3 million U.S. gallons of ultra-low sulfur diesel (ULSD) fuel. Part of the barging route will cross the Great Circle route shipping lanes entering and exiting Unimak Pass. About 6,000 fishing and commercial vessels annually pass through Unimak Pass (TRB 2008), which is nearly double that of all Alaskan ports combined. Given traffic volume, currents (up to 7 kt [13 km/hr]), weather conditions (*e.g.*, fog), mixture of vessel speeds (*e.g.*, slow tug/barges vs. much faster container ships), and remoteness, Unimak Pass has a high risk for collision (Ports and Waterways Safety Assessment 2006), potentially resulting in an oil spill. Unimak Pass traffic also poses a collision risk for Donlin Gold barges coming from Seattle, although the potential oil spill volume is limited to what fuel remains in the tugboat tanks. Unimak Pass and the Pacific Inshore route are also lined with rocky hazards, which could result in a grounding due to engine failure or other accidental reasons. Groundings in remote and rocky Alaska often result in oil release.

However, all the major oil spills mentioned in the previous section occurred in association with winter storms, and Donlin Gold barging would not occur during winter months due to sea and river ice. Also, in Alaska, operations relative to marine fuel transport and transfer are regulated by both Federal and State agencies, more specifically, the U.S. Coast Guard (USCG), U.S. Environmental Protection Agency (EPA), and the State of Alaska Department of Environmental Conservation (ADEC). The USCG requires Vessel Response Plans (VRP) that comply with 33 CFR 155 subparts D, F, G, and I.

The fuel barges from Dutch Harbor would be double-hulled, specifically designed to reduce the risk of oil release in the event of a collision. Based on worldwide oil spills analyzed between 1991 and 2003, of 53 accidents with double-hulled tankers, only four resulted in an oil spill, totaling 115,000 U.S. gallons (DeCola 2009). This compares to 105 accidents involving single-hulled tankers (without segregated ballast tanks), where 14 involved spills totaling over 70 million U.S. gallons.

Most of the proposed cargo barging coming out of Seattle will follow the Pacific Inland route. Although many portions of this route are narrow and pose a collision hazard, traffic north of Vancouver is relatively light, thereby lessening collision risk. However, Rosario Strait, running along the eastern side of the San Juan Islands, has been recognized as a waterway in Puget Sound with a high collision risk and major oil spill potential based on vessel exposure time (Van Dorp and Merrick 2014). This is because the narrow channel is shared by oil tankers moving to and from Vancouver ports and oil refineries near Anacortes and Bellingham, coupled with treacherous tidal currents. In the event of a collision, maximum oil release from the tug/barge would be limited to the diesel fuel remaining in the tugboat fuel tanks (which are largely recessed to prevent rupture in the event of a grounding). However, if the accident involves colliding with the oil tanker, the oil release could be magnitudes higher, with commensurate consequences to local marbled murrelet populations. The risk is mitigated by the USCG's Vessel Traffic Services program, which monitors all ship traffic within the confined waterways of Puget Sound, the Strait of Juan de Fuca, and Georgia Strait in cooperation with the Canadian Coast Guard under the Cooperative Vessel Traffic Agreement. This program provides real-time information to vessel captains on approaching traffic and travel conditions.

A chemical spill could also occur during a collision or allision event, including during a grounding while traveling up and down the Kuskokwim River. However, the safety measures addressed above regarding reducing oil spill risk, also apply to a chemical spill risk.

5.3. Incidental Spill

Incidental spills are chemicals spills which can be safely controlled at the time of release by shipboard personnel, do not have the potential to become an emergency within a short time, and are of limited quantity, exposure, and potential toxicity. Incidental spills also include normal vessel operational discharges such as release of ballast or bilge water that might contain oils or oily detergents from deck washdown operations. They further include accidental releases of small volumes of hydraulic fluids, motor fuels and oils, and other fluids used in normal ship operation, usually as a result of overfilling tanks. Incidental spills can also occur during vessel and transportation tank fueling at Dutch Harbor docks. The accumulation of a number of small spills can lead to impaired marine waters.

5.3.1. Relevance to Donlin Gold Barging

Incidental spills associated with Donlin Gold's barging program are most likely to occur in port (Seattle, Dutch Harbor, Bethel, Anchorage, or Beluga) during fuel and supply transfer, with the greatest risk during fuel barge filling operations at Dutch Harbor and offloading at Bethel. However, given Bethel is located nearly 70 mi (113 km) upstream from the mouth of Kuskokwim River, incidentally spilled fuel will most likely have dispersed long before reaching marine waters used by listed marine mammals.

Facility Response Plans (FRP) are also required by the USCG for transfer of fuel from marine tank vessels to shore-based fuel storage facilities. These FRP requirements are described in 33 CFR 154 subparts F, H, and I and typically regulate fuel transfer operations from the vessel to the marine header at the fuel storage terminal.

The EPA requires both Spill Prevention Control and Countermeasure (SPCC) Plans and FRPs for shore-based fuel storage facilities where over-water fuel transfers occur. These requirements are described in 40 CFR part 112.

ADEC regulates marine tank vessels in state waters, transfer of fuel across the water, and fuel storage and distribution through the requirements of 18 AAC 75. All of these various regulations stem from and are integrated through the Oil Pollution Act of 1990 (OPA 90), promulgated following the Exxon Valdez oil spill which occurred in 1989. They focus on spill prevention by specifying construction standards, use of established procedures (for example fuel transfer procedures), conduct of regular equipment inspections, and personnel training. They also focus on spill response by requiring pre-staged spill response equipment, pre-identification of sensitive areas, personnel training, and regular spill drills. Agency inspections are also important elements of assuring spill response prevention, preparation and readiness. In Alaska, both dock and vessel operations relative to fuel transfer are required to develop Oil Discharge Prevention and Contingency Plan (ODPCPs) as regulated under 18 AAC 75. The plans must include a response action plan in the event of a spill, a prevention plan detailing the best management practices that will be implemented to avoid a spill occurrence, and a review of the best available technology for detecting and recovering oil discharges.

Spill response crisis management systems that conform to the National Incident Management System (NIMS) are also required. This assures seamless integration with state and federal response resources in the event that they are needed.

Both Dutch and Iliuliuk harbors were listed as impaired waters for Settleable Solids (SS), Dissolved Oxygen (DO), and Petroleum Hydrocarbons. In 1995 a Total Maximum Discharge Load (TMDL) was established related to waste discharges from Seafood Processors. Further sampling from 2006 to 2008 indicated that while the water column met State of Alaska Water Quality Standards (WQS), sediments did not. Focus since that time has been on best management practices to minimize further petroleum hydrocarbon and other contaminant inputs.

North Pacific Fuel is regulated through an Alaska Pollutant Discharge Elimination System Multi-sector General Permit (MSGP) number AKR05DB55. The MSGP is designed to assure that all discharges from regulated facilities meet WQS. Sediment contamination is thought to be a result of historic spills, perhaps occurring as long ago as World War II when more than a million gallons of fuel was released during a Japanese bombing attack, as well as stormwater discharges from upland contaminated sites. Small spills at or near docks continue to contribute to impairment with an average of 1,000 gallons of petroleum products spilled annually into the waters or onto adjacent shorelines of Dutch and Iliuliuk harbors (ADEC 2010).

ADEC (2010) has evaluated the three bulk fuel storage and transfer facilities (Delta Western and two North Pacific Fuel facilities) and written “The three facilities appear to have implemented BMPs [Best Management Practices], developed the appropriate plans for spill scenarios, and properly managed their operations. There is no indication that these facilities are chronic sources of petroleum pollutants for the study area”. But they did recognize that the almost 20 million gallons of fuel stored does pose a potential high risk to water quality.

The primary issue with incidental spills is the chronic impairment of water quality, and in this case sheen on sediment. O’Hara and Morandin (2010) studied the effects of petroleum sheens on pelagic seabirds and found that even very small quantities of oil sheen can change the microstructure of feathers leading to lethal thermoregulation problems in seabirds. Sea otters are also susceptible to oil fouling their fur and reducing the animal’s ability to thermoregulate (Kenyon 1969, Geraci and Williams 1990). Cimberg and Costa (1985) found that even lightly oiled animals spent an inordinate amount of time and energy grooming to remove the oil, and for the most part only spread it into clean areas and deeper into the fur. Geraci and Williams (1990) described the consequences as such:

> “A more extensive coating of oil would likely have tipped the balance and delivered the otters….in a tightening metabolic spiral: oil fouls the fur, reduces its insulative properties, and increases heat loss; the animal compensates by increasing its metabolic rate which, in turn, it must fuel by consuming more food; but eating gives way to vigorous grooming, and that energy squandered on spreading the oil, is not restored; body mass decreases and more heat is lost.”

Pups are most vulnerable.

5.4. Effects to Prey

For the listed species addressed in this assessment, four species are primarily benthic feeders (Northern sea otter, Pacific walrus, spectacled eider, and Steller’s eider), while the remaining two (marbled murrelet and short-tailed albatross) feed on small schooling fish, shrimp, squid, and zooplankton. Sessile bivalves are major component of the diet of otters, walrus, and eiders, although eiders and otters also feed on crustaceans. In addition, otters in the Aleutians feed on urchins. All these benthic species could become contaminated from spills leading to bioaccumulation or biomagnification of toxins in listed species. Contamination risks would be highest where otters feed near fuel transportation facilities, or after a major oil spill that results in oil reaching benthic habitats (perhaps where dispersants result in floating oil particles sinking to the seafloor).

Barging activity can directly affect plankton, fish eggs, fish larvae, and small fish through hull shear, entrainment through the propulsion system, exposure to turbulence in the propeller wash, and wake stranding (Odom *et al.* 1992). However, studies have found it difficult to detect barge-related mortality (Holland 1986, Odom *et al.* 1992), and have found fish larvae to be relatively resilient. Wake stranding, the depositing of fish onto shore by vessel-induced waves, is a function of wave amplitude, which further is a result of vessel size, draft, speed, and distance of vessel from shore (Bauersfeld 1977). Ackerman (2002) studied salmonid stranding in the lower Columbia River and found that shallow-draft tugs pulling barges produced much smaller wake amplitudes (average of 0.52 ft [0.15 m]) than larger, deep-draft ships (1.7 ft [0.52 m]), and all but one of the observed salmonid strandings were associated with deep-draft ships. The distances to shore during this study ranged from 780 to 1,630 ft (238-497 m), or much closer to shore than the proposed travel routes for the Donlin barging. Thus, the Donlin barges probably do not produce large enough wakes and are not close enough to shore to cause any significant wave mortality stranding of prey fish.

Acoustical effects to prey resources are also limited. Christian *et al.* (2004) studied seismic energy impacts on male snow crabs (*Chionoecetes* sp.) and found no significant increases in physiological stress due to exposure. No acoustical impact studies have been conducted to date on Alaskan fish species, but studies have been conducted on Atlantic cod (*Gadus morhua*) and sardine (*Clupea* sp.). Davis *et al.* (1998) cited various studies and found no effects to Atlantic cod eggs, larvae, and fry when received levels were 222 dB. Effects found were to larval fish within about 16.4 ft (5 m), and from air guns with volumes between 3,000 and 4,000 cubic inches. Similarly, effects to sardines were greatest on eggs and 2-day larvae, but these effects were also confined to 16.4 ft (5 m). Further, Greenlaw *et al.* (1988) found no evidence of gross histological damage to eggs and larvae of northern anchovy (*Engraulis mordax*) exposed to seismic air guns, and concluded that noticeable effects would result only from multiple, close exposures. All these studies involved impulsive noise of very high energy, much higher than the continuous noise associated with tug propeller cavitation. Given the little response of potential prey to impulsive noise, the noise associated with barging activity is not likely to affect benthic or fish prey.

6. DIRECT EFFECTS

6.1. Insignificant and Discountable Effects

The Endangered Species Consultation Handbook describes insignificant effects as those that are so small that they “should never reach the scale where take occurs”, and discountable effects “are those extremely unlikely to occur”. A Donlin barging accident resulting in an oil or chemical spill represents a low likelihood, high impact event. The impacts of a spill could range from negligible to high depending on the nature and amount of material spilled, environmental factors, and response. Neither an oil nor chemical spill event, should it occur, could be considered insignificant if listed species were present in the affected area. However, if the risk of such a spill were low enough, the effects would be discountable. The following sections address the oil and chemical spill risk associated with Donlin’s proposed barging.

6.1.1. Risk of Oil Spill

The maximum fuel capacity for type Ocean Class tugboats is 6,000 barrels (bbl), while the fuel barges will transport up to 69,000 bbl. Annually, these fuel barges will make about 14 round trips between Dutch Harbor and Bethel during mine operation, plus an additional three to six trips over the three to four construction years. All barge fuel tanks will be double-hulled.

Accident and fuel spill risks from fuel transportation have been analyzed. Papanikolaou *et al.* (2006), analyzed hull design relative to tanker accidents worldwide. For the period of 1991-2003, when double-hulled tankers became common, the study found that 53 accidents with double-hulled tankers produced 4 spills over a period of 2,133 shipyears. The total quantity of spills was 2,707 bbl or 1.3 bbl per shipyear. In contrast, during 2,137 single-hull shipyears (over the same 13-year period) 105 accidents occurred, resulting in 14 spills. The total amount spilled – 1,654,761 bbl – was much higher with 774 bbl spilled per shipyear. A few very large spills accounted for most of the oil loss. Although this analysis was limited to tankers, the fact remains that double-hulled tank use has dramatically reduced both the number and volume of spills worldwide. In addition, navigation and vessel control technology has advanced further reducing spill risk.

More specific to Donlin Gold’s project, Anderson et al. (2012) analyzed the occurrence rate for offshore oil spills, including barge oil spill rates in all US waters (marine and inland). Between 1991 and 2008, there were 34 barge oil spills of 1,000-10,000 bbl, 3 of 10,000-25,000 bbl, and 1 greater than 25,000 bbl. This equated to 2.1 spills greater than 1,000 bbl per year nationwide. During that period 1.6 to 1.8 billion barrels (Bbbl) of oil was transported annually. Between the periods of 1974 and 1993, and 1994 and 2008, the barge spill rates declined dramatically. The spill rate for spills greater than 1,000 bbl dropped from 3.37 (1974-1993) to 1.20 (1994-2008) spills per Bbbl transported, while for spills greater than 10,000 bbl, the rate dropped from 0.81 to 0.16 spills per Bbbl transported. They attributed the declines to the transition to double-hulled tanks.

The information above was used to estimate the risk of an oil spill associated with the Donlin Project. The Project includes transport from Dutch Harbor to Bethel a maximum of 69,000 bbl per trip or about 1 million bbl per year. Given a spill rate of 1.20 spills per Bbbl (spills greater than 1,000 bbl) based on Anderson et al (2012), the annual spill risk for the Donlin Gold’s estimated yearly transport of 1 million bbl is 0.0012. Over 35 years, the greater than 1,000 bbl spill risk is 0.042 (for 35 million bbl transported). For a spill over

10,000 bbl, the annual risk is 0.00016, and over 35 years is 0.0056. The PDEIS stated that the probability of spills of these sizes occurring is very low (defined as a probability of approaching zero).

The spill risks identified above, (0.0012 for a spill of greater than 1000 bbl and 0.0056 for a spill of greater than 10,000 bbl over 35 years) are low enough to be defined as discountable.

6.1.2. Risk of Chemical Spill

The risk of a chemical spill during barging that would result in not just a spill, but a release of a size that could adversely affect a listed species or critical habitat is extremely low. The pathway for a chemical spill to affect a listed species or critical habitat would start with a barging accident that affected the particular chemical container. That container would need to be breached and the contents come into contact with the environment. Finally, there would need to be receptors (listed species) present to be exposed to the contaminated water. The details regarding spill risk and controls can be found in Section 3.24 of the Donlin Gold Project PDEIS.

A chemical spill into water would likely be the result of a major or catastrophic barge incident. Saricks and Tompkins (1999) estimated the risk of a barge accident (allisions, collisions, breakaways, fires, explosions, groundings, structural failures, flooding, capsizing, and sinking) that occurred within 100 mi (160 km) of the coastline. The risk is 5.29 $x10^{-7}$ accident per 500 metric ton (t)/km. Over the life of the mine operations this translates to 0.00013[1] accidents. It is important to note that a barge accident may or may not result in a chemical spill to water. Therefore, the risk of a chemical spill would be less than 0.00013 over the life of the mine. Similarly, the PDEIS stated that the risk of a cyanide spill would be very low (defined as a probability approaching zero).

This is an extremely low accident risk and, based on precedent, is discountable for the purposes of the ESA.

6.2. Northern Sea Otter

6.2.1. Disturbance

Available evidence suggests that sea otters are little disturbed by vessel noises. Given the nearshore distribution of this species relative to the barge traffic channels in Alaska, direct encounters are relatively remote for both the Pacific Inshore and Offshore routes. Visual encounters with otters are most likely to occur during fuel barge trips in and out of Unalaska Bay, although these otters are well accustomed to vessel noise given the fishing vessel traffic in the bay. The proposed barging operations are unlikely to disturb listed northern sea otters to any levels of concern. However, given the presence of otters and the fact that pupping probably occurs in Unalaska Bay, the determination is **May Affect, Not Likely to Adversely Affect** for disturbance.

6.2.2. Accidental Oil or Chemical Spill

A major oil spill event could have a dramatic impact on sea otter populations as evidenced by the several thousand killed during the *Exxon Valdez* spill event in 1989. However, while USFWS (2013) recognized

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[1] (Accident Rate) x $\frac{Total\ distance\ traveled\ with\ Cargo\ (km)}{Total\ Cargo\ \ (st)}$ therefore $5.29\ \cdot 10^{-7} \cdot \frac{500\ st}{1\ km} \cdot \frac{1973277.6\ km}{3981547\ st} = 0.00013$

the particular vulnerability of sea otters to oil, they classified oil spills as a risk factor of only low to moderate importance. This is because of the infrequency of bulk oil tanker traffic in the DPS range (about 40 pass through Unimak Pass annually), and that most spills would be of smaller volumes of diesel fuel. Diesel fuel is "less toxic and disperses and evaporates much more rapidly than crude oil" (USFWS 2013). A moderate ranking for oil spill risk was justified for the sea otter management units associated with Unimak Pass and the shipping routes into Cook Inlet due to the traffic volume, but the management potential for cleanup and containment of a small spill was thought to be high. Thus, while a diesel fuel spill might result in the harm of a number of local sea otters, the potential volume of spill, and rate of dispersion and evaporation, would limit the area impacted and depend on whether a tug fuel tank or fuel barge is involved.

The Donlin Gold fuel barging program will reduce oil spill risk by operating in summer months when weather conditions are moderate, by using barges with double-hull tanks to reduce the potential for complete tank rupture, and by using updated radar equipment to avoid other vessels traveling in the proximity. While the risk of an oil spill associated with Donlin Gold's barging operations is highest while traveling in the vicinity of Unimak Pass, the overall risk is low to the point of discountable, based on the safety measures mentioned in Section 6.1.1. Further, the risk of a chemical spill is discountable based on the spill risk analysis in Section 6.1.2. Thus, the determination is **May Affect, Not Likely to Adversely Affect** for accidental oil or chemical spill.

6.2.3. Incidental Oil Spill

Surface waters in Dutch and Iliuliuk harbors are no longer considered impaired by incidental discharges from industrial and fishing activities at Dutch Harbor and Unalaska, but sediments remain impaired due to lingering petroleum sheens. These petroleum sheens could affect northern sea otters, if benthic feeding individuals were to come into contact with them, by reducing the thermoregulatory properties of their fur (see Section 5.3.1). Also, sea otters are often observed near the docks and could be present during an incidental spill event. In either event, individual sea otters could be harmed, but population level affects would not occur. The determination is **May Affect, Not Likely to Adversely Affect** for incidental oil spill.

6.2.4. Effects to Critical Habitat

The proposed barging routes will pass very close to northern sea otter designated critical habitat where it traverses through the Semidi, Shumagin, and Sanak islands south of the Alaska Peninsula, and during travel in and out of Dutch Harbor. Thus, barging has a chance, albeit low, of disturbing sea otters or exposing them to an incidental spill at Dutch Harbor. A large accidental spill might have a population effect on local sea otters given the otter densities and their susceptibility to oil fouling of their insulating fur. However, the risk of an accidental spill is discountable. Thus, the determination for Donlin Gold's barging project is **May Affect, Not Likely to Adversely Affect** for northern sea otter critical habitat.

6.3. Pacific Walrus

6.3.1. Disturbance

Bristol Bay walrus haulout sites occur from 30 mi to 115 mi (48-185 km) from the proposed Bering Sea route between Dutch Harbor/Unimak Pass and Bethel. Thus, disturbance risk to these summer haulouts is non-existent. The determination for disturbance risk is **No Effect**.

6.3.2. Accidental Oil or Chemical Spill

Collision and grounding risks are low given the lower large vessel traffic in Bristol Bay and shoreline topography. Further, diesel is of low viscosity and rapidly dilutes when spilled, and is much lighter than water and will not accumulate in bottom sediments. Thus, any diesel fuel reaching areas used by walrus is expected to be diluted to levels well below contact harm, and would not accumulate in the benthic feeding habitat. A collision with one of the 40 crude oil tankers that annually pass through Unimak Pass, however, might result in a crude oil spill with coastal currents transporting this oil well into Bristol Bay, although this collision risk is very low and considered discountable (see Section 6.1.1). Also, as described in Section 6.1.2, the risk of a chemical spill is discountable. The determination is **May Affect, Not Likely to Adversely Affect** for accidental oil or chemical spill.

6.3.3. Incidental Oil Spill

Walrus do not occur near Dutch Harbor and would not be exposed to an incidental spill that might occur there. The determination for incidental spill risk is **No Effect**.

6.3.4. Effects to Critical Habitat

Critical habitat has not been designated for Pacific walrus.

6.4. Marbled Murrelet

6.4.1. Disturbance

There is no evidence that the continuous noise associated with the barging operation would disturb listed populations of marbled murrelets in Washington or British Columbia. These birds generally do not forage in the mid-channel shipping lanes, and the noise impact concerns with these birds have been limited to loud impulsive noises from activities such as pile driving. Only the mere presence of the bird in the same inland waters where the barging will occur warrants a determination of **May Affect, Not Likely to Adversely Affect**.

6.4.2. Accidental Oil or Chemical Spill

The greatest risk the barging operation would have to listed murrelets is an accidental oil spill associated with a collision or grounding in the traffic-heavy inland waters of Washington and British Columbia, especially in Rosario Strait where oil tanker traffic is high and tidal currents can create navigation problems. However, this risk is mitigated by the United States Coast Guard's Vessel Traffic Services program, which provides real-time information to vessel captains on approaching traffic and travel conditions, and reduces the risk of an accident leading to a spill is discountable. Thus, the determination for accidental oil or chemical spill is **May Affect, Not Likely to Adversely Affect**.

6.4.3. Incidental Oil Spill

Marbled murrelets do not occur in any identifiable numbers in the industrial harbor waters of Seattle where they might be exposed to an incidental petroleum or chemical spill during barge loading or fueling activities. Marbled murrelets may forage in marine waters near Dutch Harbor, but this species is not listed in Alaska. The barging project would have **No Effect** on marbled murrelets for incidental spills.

6.4.4. Effects to Critical Habitat

Marbled murrelet critical habitat has been designated for inland breeding areas only. The Donlin project will have **No Effect** on designated critical habitat.

6.5. Short-tailed Albatross

6.5.1. Disturbance

Short-tailed albatrosses are primarily a shelf edge species in Alaska. Potential encounters with Donlin Gold proposed barging is limited to the short (approximately 50 mi [80 km]) portion of the Pacific Offshore route that crosses shelf-edge water. This species commonly feeds on offal from fishing factory ships, thus is relatively immune to vessel noise. Also, the probability of a barge encountering an albatross such that it would result in a behavioral effect is unlikely. The determination is **No Effect** for disturbance.

6.5.2. Accidental Oil or Chemical Spill

The greatest risk to short-tailed albatrosses from barging activity is probably an oil spill event resulting from a collision in the traffic-crowded Unimak Pass. Oil spill trajectories north or south of the pass could reach short-tailed albatross feeding habitat. However, this risk is low to the point of discountable, thus the determination for accidental oil spill is **May Affect, Not Likely to Adversely Affect**.

6.5.3. Incidental Oil Spill

Albatrosses are not found in harbor waters where they could be exposed to an incidental spill. The determination for incidental spill is **No Effect**.

6.5.4. Effects to Critical Habitat

The FWS has determined that designating critical habitat is not prudent for the short-tailed albatross.

6.6. Spectacled Eider

6.6.1. Disturbance

The nearest spectacled eider use area to a proposed barging route is the Yukon-Kuskokwim Delta nesting area located over 80 mi (129 km) north of the Bering Sea route. Therefore, the Donlin barging activity will have **No Effect** on these sea ducks from disturbance.

6.6.2. Accidental Oil or Chemical Spill

The only risk to the very few remaining spectacled eiders that nest in the Yukon-Kuskokwim Delta, the nearest spectacled eider use to the barging routes, is from an oil spill that might transport north from a spill event in Kuskokwim Bay. However, the risk is negligible because the risk of a spill is discountable. The only oil that would be involved would be diesel fuel which quickly disperses and would not likely remain at harmful concentrations by the time it reaches the Yukon-Kuskokwim Delta. Diesel fuel does not sink down to bottom sediments where eider benthic prey reside, and much of the eider feeding during the breeding season occurs in freshwater ponds. Also, as discussed in Section 6.1.2, the chances of an accident leading to a chemical spill are remote and discountable. The determination for accidental oil or chemical spill is **May Affect, Not Likely to Adversely Affect**.

6.6.3. Incidental Oil Spill

Spectacled eiders do not inhabit the port waters of Dutch Harbor and, therefore, are unlikely to be exposed to an incidental spill that might be associated with fuel transfer at the harbor. The determination is **No Effect** for incidental oil spill.

6.6.4. Effects to Critical Habitat

The nearest spectacled eider critical habitat occurs over 80 mi (129 km) north of the Bering Sea barging route. At this distance, the likelihood of an oil spill from a Donlin barging accident reaching this critical habitat during the nesting season is discountable. Thus, the barging activity **May Affect, Not Likely to Adversely Affect** spectacled eider critical habitat.

6.7. Steller's Eider

6.7.1. Disturbance

Direct encounters of Steller's eiders with barging operations are not likely. Late summer molting occurs in the lagoons along the north side of the Alaska Peninsula and at Kuskokwim Shoals at the north end of Kuskokwim Bay (Figure 3), and eider use in Unalaska Bay and south of the Alaska Peninsula occurs during the fall and winter outside the barging season. These eiders do not breed anywhere along the barging routes. Thus, barging operations would not directly disturb these eiders because there is no temporal overlap of common use areas. The determination is **No Effect** for disturbance to Steller's eiders.

6.7.2. Accidental Oil or Chemical Spill

An accidental oil spill due to a collision or grounding in Unalaska Bay, near Unimak Pass, or approaching the Kuskokwim River could result in released diesel fuel reaching molting and wintering grounds. However, given the limited potential size of a barge spill, the dispersion and evaporation properties of diesel, and the fact that diesel is too light to contaminate benthic foraging habitat, the accidental oil spill risk to Steller's eiders is very low to the point of discountable. Although, because birds moving between breeding and molting areas must cross the Bering Sea barging routes, the risk of exposure to a Bristol Bay oil spill cannot be totally eliminated. However, the risk of an accident leading to either a fuel or chemical spill is discountable (see Sections 6.1.1 and 6.1.2). Therefore, the determination for accidental oil or chemical spill is **May Affect, Not Likely to Adversely Affect** for Steller's eiders.

6.7.3. Incidental Oil Spill

For the same reason described in Section 6.7.1 (no temporal overlap), any incidental spill associated with a Donlin barging operation in Dutch Harbor would not directly impact Steller's eiders using Unalaska Bay months later. For incidental oil spill the determination is **No Effect**.

6.7.4. Effects to Critical Habitat

Steller's eider critical habitat occurs at the Kuskokwim Shoals unit molting area, and at three molting/wintering areas along the northwest coast of the Alaska Peninsula (Izembek Lagoon, Nelson Lagoon, and Seal Island units). The Kuskokwim Shoals area is located about 50 mi (80 km) northwest of the Bering Sea barging route, while the three Alaska Peninsula units are about 100 to 200 mi (160-320 km) from the Bering Sea route. None of these areas would be affected by barging disturbance or incidental spill. The possibility of an accidental oil spill reaching these areas exists, but the risk of a spill event is discountable. Therefore, the Donlin barging project **May Affect, But Not Likely Adversely Affect** Steller's eider designated critical habitat.

7. INDIRECT EFFECTS

The Donlin Gold barging program will be implemented to supply fuel and cargo to a planned gold mine located more than 250 mi (400 km) up the Kuskokwim River. Other than the barging activity addressed in this assessment, there are no other mine components or activities that involve marine waters, other than additional fuel transport to Dutch Harbor to supply Donlin Gold's fuel vendors located at Dutch Harbor. This fuel transport is not specifically addressed in this assessment as it is part of normal business operation for Dutch Harbor fuel vendors. Until fuel transport to Dutch Harbor is better understood, this future activity and associate risk remain speculative.

The risk of an oil spill has already been determined to be a discountable direct effect. However, should a spill occur, there are potential indirect effects associated with cleanup. The type of synthetic materials used to disperse or clean up fuel can influence the magnitude of effect on listed wildlife (Ober 2013). While dispersants can increase the rate of oil degradation and thereby reduce the effects from surface toxicity or degradation of shoreline habitats, they also are surfactants that can reduce the insulation abilities of bird feathers and cause floating oil particles to sink down to benthic habitats. In addition, cleanup involves a large amount of human activity with associated additional disturbance risk to wildlife.

No other indirect effects have been identified.

8. CUMULATIVE EFFECTS ANALYSIS

For purposes of consultation under the ESA, cumulative effects are future state or private activities that are reasonably certain to occur within the action are, that do not involve federal activities subject to consultation. Relative to barging, the action areas are the barging routes between Seattle and Bethel, Dutch Harbor and Bethel, and Anchorage and Beluga. Actions similar to Donlin Gold's barging program are the existing shipping traffic along these routes that also contribute to noise and spill hazard. Donlin Gold's operation will add to the shipping traffic in Washington, British Columbia, and Alaska, but by no more than 0.5% over existing traffic. However, with the expected increase in shipping traffic volume through the Strait of Juan de Fuca and Unimak Pass over the approximate 35-year barging program, especially with anticipated increases in tanker ship traffic carrying Canadian crude oil to China over the Great Circle route, Donlin Gold cargo barges will be traversing more crowded shipping lanes leading to an increase in collision risk. Further, Unimak Pass is a conduit to oil and gas exploration and increased cargo traffic to and through the Alaskan Arctic. Donlin Gold barging can expect to be part of an anticipated increase in Alaskan shipping traffic congestion. Several projects are planned for Cook Inlet that would also contribute noise risk to local marine mammals including the Alaska LNG pipeline project, the Chuitna coal terminal project, and several oil & gas seismic and drilling programs planned in both upper and lower Cook Inlet. All these projects will have associated mitigation and monitoring plans designed to limit impacts to Cook Inlet marine mammals.

9. DETERMINATION OF EFFECTS SUMMARY

A determination of effects for each species for the three evaluated risk categories is found in Table 3.

TABLE 3: DETERMINATION OF EFFECTS FOR EACH ESA LISTED SPECIES POTENTIALLY OCCURRING ALONG DONLIN GOLD'S PROPOSED BARGING ROUTES.

Species	Disturbance	Accidental Oil Spill	Incidental Oil Spill	Critical Habitat	Overall
Northern Sea Otter	NLAA	NLAA	NLAA	NLAA	NLAA
Pacific Walrus	NE	NLAA	NE	N/A	NLAA
Marbled Murrelet	NLAA	NLAA	NE	NE	NLAA
Short-tailed Albatross	NE	NLAA	NE	N/A	NLAA
Spectacled Eider	NE	NLAA	NE	NLAA	NLAA
Steller's Eider	NE	NLAA	NE	NLAA	NLAA

NE = No Effect
NLAA = May Affect, Not Likely to Adversely Affect
N/A = Not Applicable

10.LITERATURE CITED

Ackerman, N.K. 2002. Effects of vessel wake stranding of juvenile salmonids in the lower Columbia River, 2002 – a pilot study. S.P. Cramer & Associates report to USACOE, Portland. 47 pp.

Alaska Department of Environmental Conservation (ADEC). 2010. Total Maximum Daily Loads (TMDLs) for Petroleum Hydrocarbons in the Waters of Dutch Harbor and Iliuliuk Harbor in Unalaska, Alaska. Alaska Department of Environmental Conservation, 555 Cordova Street, Anchorage, Alaska 99501. 75 pp.

Anderson, C.M., M. Mayes, and R. LaBelle. 2012. Update of Occurrence Rates for Offshore Oil Spills. OCS Report BOEM 2012-069 and BSEE 2012-069. 76 pp.

Arveson, P.T. and D.J. Vendittis. 2000. Radiated noise characteristics of a modern cargo ship. Journal of the Acoustical Society of America 107:118–129.

Austin, O.L. 1949. The Status of Steller's Albatross. Pacific Science 3:283-295.

Balcomb, K.C. and D.E. Claridge. 2001. A mass stranding of cetaceans caused by naval sonar in the Bahamas. Bahamas Journal of Science 8:1-12.

Bassett C., B. Polagye, M. Holt, and J. Thomson. 2012. A vessel noise budget for Admiralty Inlet, Puget Sound, Washington (USA). Journal of the Acoustical Society of America 132:3706-3719.

Bauersfeld, K. 1977. Effects of peaking (stranding) of Columbia River Dams on juvenile anadromous fishes below the Dalles Dam, 1974 and 1975. State of Washington Department of Fisheries report to the U.S. Army Corps of Engineers, Contract DACW 57-74-C-0094, 32 pp.

Beissinger, S.R. 1995. Population trends of the Marbled Murrelet projected from demographic analyses. *In*: Ecology and Conservation of the Marbled Murrelet. Ralph, C.J., Hunt Jr., G.L., Raphael, M.G. & Piatt, J.F. (Eds.). USDA Forest Service General Technical Report PSW-GTR-152. pp. 385-393.

Bodkin, J.L., D. Mulcahy, and C.J. Lensink. 1993. Age-specific reproduction in female sea otters (*Enhydra lutris*) from south-central Alaska: analysis of reproductive tracts. Canadian Journal of Zoology. 71:1811-1815.

Bodkin, J.L. and M.S. Udevitz. 1999. An aerial survey method to estimate sea otter abundance, pg. 13-27 In: Marine Mammal Survey and Assessment Methods. Garner, G.W., Amstrup, S.C., Laake, J.L., Manly, B.J.F., McDonald, L.L., and Robertson, D.G., eds., AA Balkema, Rotterdam, Netherlands.

Bodkin, J.L. 2000. Sea otters past and present perspectives. Alaska Geographic 7:73-93.

Bodkin, J.L. and D.H. Monson. 2002. Sea otter population structure and ecology on Alaska. Arctic Research of the United States 16:31-36.

Bodkin, J.L., D.H. Monson, and G.E. Esslinger. 2003. A report on the results of the 2002 Kenai Peninsula and Lower Cook Inlet aerial sea otter survey. USGS Report. 10 pp.

Bodkin, J.L., Esslinger, G.J., Monson, D.H. 2004. Foraging depths of sea otters and implications to coastal marine communities. Marine Mammal Science 20:305-321.

Bowles, A.E., Smultea, M., Würsig, B., DeMaster, D.P. & Palka, D. 1994. Relative abundance and behavior of marine mammals exposed to transmissions from the Heard Island Feasibility Test. Journal of the Acoustical Society of America 96:2469–2484.

Burger, A.E. 2002. Conservation assessment of Marbled Murrelets in British Columbia: review of the biology, populations, habitat associations, and conservation. Technical Report Series No. 387. Canadian Wildlife Service, Pacific and Yukon Region, Delta, B.C.

Burger, A. and D. Fry. 1993. Effects of oil pollution on seabirds in the northeast Pacific. In: Vermeer, K., Briggs, K., Morgan, K. & Siegel-Causey, D. (Eds). The status, ecology, and conservation of marine birds of the North Pacific. Ottawa: Canadian Wildlife Service. pp. 254–263.

Burn, D.M. and A.M. Doroff. 2005. Decline in sea otter (*Enhydra lutris*) populations along the Alaska Peninsula, 1986-2001. Fishery Bulletin, 103:270-279.

Bustnes, J.O. and Systad, G.H. 2001. Habitat use by wintering Steller's Eiders *Polysticta stelleri* in northern Norway. Ardea 89:267-274.

Calvert, W. and Stirling I. 1990. Interactions between polar bears and overwintering walruses in the central Canadian High Arctic. International Conference on Bear Research and Management 8:351-356.

Carter, H.R. and R.A. Erickson. 1992. Status and conservation of the marbled murrelet in California, 1892-1987. *In*: H.R. Carter and M.L. Morrison (eds.). Status and conservation of the marbled murrelet in North America. Proc. West. Found. Vert. Zool. 5:92-108.

Chivers, S.J. 1999. Biological indices for monitoring population status of walrus evaluated with an individual-based model. Pages 239-247, *In* Garner, G.W., S.C. Amstrup, J.L. Laake, B.F.J. Manly, L.L. McDonald, and D.G. Robertson (eds.), Marine Mammal Survey and Assessment Methods. A. A. Balkema, Rotterdam, 287 pp.

Christian, J.R., A. Mathieu, and R.A. Buchanan. 2004. Chronic effects of seismic energy on snow crab (*Chionoecetes opilio*). Environmental Studies Research Funds Report No. 158, Calgary, AB.

Cimberg, R.L. and D.P. Costa. 1985. North Aleutian Shelf sea otters and their vulnerability to oil. In: Oil Spill Conference proceedings (prevention, behavior, control, cleanup). Los Angeles, CA. Amer. Petroleum Institute Publ. No. 4385:211-217.

Dall, W.H. 1873. Notes on the avifauna of the Aleutian Islands, especially those west of Unalaska. Proc. Calif. Acad. Sci. (first series) 5:270-281.

Dau, C.P. and S.A. Kistchinski. 1977. Seasonal movements and distribution of the spectacled eider. Wildfowl. 28:65–75.

Davis, R.A., D. Thomson, and C.I. Malme. 1998. Environmental assessment of seismic exploration of the Scotian Shelf. Unpublished Report by LGL Ltd., environmental research associates, King City, ON and Charles I. Malme, Engineering and Science Services, Hingham, MA for Mobil Oil Canada Properties Ltd, Shell Canada Ltd., and Imperial Oil Ltd.

Day, R.H. 1998. Predator populations and predation intensity on tundra–nesting birds in relation to human development. Report prepared by ABR Inc., for Northern Alaska Ecological Services, U.S. Fish and Wildlife Service, Fairbanks, Alaska. 106 pp.

DeCola, E. 2009. A review of double hull tanker oil prevention considerations. Nuka Research & Planning Group report to Prince William Sound RCAC. 34 pp.

DeGange, A.R., A.M. Doroff and D.H. Monson. 1994. Experimental recovery of sea otter carcasses at Kodiak Island following the Exxon Valdez oil spill. Mar. Mamm. Sci. 10:496-501.

DeMaster, D.P. 1984. An analysis of a hypothetical population of walruses. Pg. 77-80, *In* F.H. Fay and G.A. Fedoseev (eds.), Soviet American Cooperative Research on Marine Mammals, vol. 1, Pinnipeds. NOAA Technical Report, NMFS 12, 104 pp.

Donlin Gold. 2012. Vessel Operations, Oil Discharge Prevention and Contingency Plan – Plan of Operations - Volume VI B, Donlin Gold Project.

Donlin Gold. 2015. Response to RFAI #56 – Mercury and Cyanide Spill Response.

Doroff, A.M., J.A. Estes, M.T. Tinker, D.M. Burn, and T.J. Evans. 2003. Sea otter population declines in the Aleutian Archipelago. J. Mammalogy, 84:55-64.

Ely. C.R., C.P Dau, and C.A. Babcock. 1994. Decline in a population of Spectacled Eiders nesting on the Yukon-Kuskokwim Delta, Alaska. Northwestern Nat. 75:81-87.

Estes, J.A., R.J. Jameson, and A.M. Johnson. 1981. Food selection and some foraging tactics of sea otters. Pages 606-641 in J.A. Chapman and D. Pursley, eds. Worldwide furbearer conference proceedings, Frostburg, MD.

Estes, J.A. 1990. Indices used to assess status of sea otter populations: a reply. Journal of Wildlife Management. 54:270-272.

Estes, J.A., Tinker, M.T., Williams, T.M., and D.F. Doak. 1998. Killer whale predation on sea otters linking oceanic and nearshore ecosystems. Science 282:473-476.

Estes, J.A. and J.L. Bodkin. 2002. Otters. Pages 842-858 *in* W.F. Perrin, B. Wursig, and J.G.M. Thewissen, eds. Encyclopedia of marine mammals. Academic Press, San Diego.

Estes, J.A., Tinker, M.T., Doroff, A.M. and Burn, D.M. 2005. Continuing sea otter population declines in the Aleutian archipelago. Marine Mammal Science 21:169-172.

Evers, D.C., J.D. Paruk, J.W. McIntyre, and J.F. Barr. 2010. Common Loon (*Gavia immer*). The Birds of North America Online (A. Poole, ed.) Ithaca: Cornell Lab of Ornithology (http:bna.birds.cornell.edu/bna/species/313).

Fay, F.H. and B.P. Kelly. 1980. Mass natural mortality of walruses (*Odobenus rosmarus*) at St. Lawrence Island, Bering Sea, autumn 1978. Arctic 33:226-245.

Fay, F.H. 1982. Ecology and Biology of the Pacific Walrus (*Odobenus rosmarus* divergens). North American Fauna 74. U.S. Fish and Wildlife Service, Washington, DC. 279 pp.

Fay, F.H., B.P. Kelly, and J.L. Sease. 1989. Managing the exploitation of Pacific walruses: A tragedy of delayed response and poor communication. Marine Mammal Science 5:1-16.

Fay, F.H., L.L. Eberhardt, B.P. Kelly, J.J. Burns, and L.T. Quakenbush. 1997. Status of the Pacific walrus population, 1950-1989. Marine Mammal Science 13:537-565.

Flint, P.L and J.B. Grand. 1997. Survival of spectacled eider adult females and ducklings during brood rearing. Journal of Wildlife Management 61:217–221.

Flint, P. L. and M. P. Herzog. 1999. Breeding of Steller's Eiders on the Yukon-Kuskokwim Delta, Alaska. Canadian Field-Naturalist 113:306–308.

Flint, P.L., J.B. Grand, J.A. Morse, and T.F. Fondell. 2000. Late summer survival of adult female and juvenile spectacled eiders on the Yukon–Kuskokwim Delta, Alaska. Waterbirds 23:292–297.

Fredrickson, L. H. 2001. Steller's eider *Polysticta stelleri*. No. 177 *In* A. Poole and F. Gill (eds.). The Birds of North America. The Academy of Natural Sciences, Philadelphia, and The American Ornithologist's Union, Washington, D.C.

Garlich-Miller, J.L. and R.E.A. Stewart. 1999. Female reproductive patterns and fetal growth of Atlantic walruses *Odobenus rosmarus rosmarus* in Foxe Basin NT, Canada. Marine Mammal Science 15:179-191.

Garlich-Miller, J.L. and C.V. Jay. 2000. Proceedings of a workshop concerning walrus survey methods. USFWS R7/ MMM Technical Report 00-2, 92 pp.

Garlich-Miller, J.L., L.T. Quakenbush, and J.F. Bromaghin. 2006. Trends in age structure and productivity of Pacific walruses harvested in the Bering Strait region of Alaska, 1952-2002. Marine Mammal Science 22:880-896.

Garlich-Miller, J.L., J.G. MacCracken, J. Snyder, R. Meehan, M.J. Myers, J.M. Wilder, E. Lance, and A. Matz. 2011: Status review of the Pacific walrus (*Odobenus rosmarus divergens*). U.S. Fish and Wildlife Service, Marine Mammals Management, January 2011, Anchorage, AK, 155 pp.

Garshelis, D.L. 1983. Ecology of sea otters in Prince William Sound, Alaska. Ph.D. dissertation, University of Minnesota, Minneapolis, MN. 321 pp.

Geraci J.R. 1990. Physiologic and toxic effects on cetaceans. Pg. 167-197 In: Geraci JR, editor; St Aubin DJ, editor. Sea Mammals and Oil: Confronting the Risks. San Diego, CA, USA: Academic Press.

Geraci, J.R., and T.D. Williams. 1990. Physiologic and toxic effects on sea otters. Pgs. 211-221. In: J.R Geraci and D.J. St. Aubin (eds.). Sea mammals and oil: confronting the risks. Academic Press, Inc. 282 pp.

Ghoul, A. and C. Reichmuth. 2012. Aerial hearing sensitivity in a southern sea otter (*Enhydra lutris nereis*). 164th Meeting of the Acoustical Society of America. Kansas City, Missouri, 22-26 October, p. 2008.

Ghoul, A. and C. Reichmuth. 2014. Hearing in the sea otter (*Enhydra lutris*): auditory profiles for an amphibious marine carnivore. Journal of Comparative Physiology A, Original Paper. 15 pp.

Gilbert, J., G. Fedoseev, D. Seagars, E. Razlivalov, and A. Lachugin. 1992. Aerial census of Pacific walrus 1990. U.S. Department of the Interior, U.S. Fish and Wildlife Service, Technical Report MMM 92-1, Anchorage, AK, 33 pp.

Gilbert, J.R. 1999. Review of previous Pacific walrus surveys to develop improved survey designs. Pg. 75-84 in: Garner, G.W., S.C. Amstrup, J.L. Laake, B.F.J. Manly, L.L. McDonald, and D.G. Robertson

(Eds), Marine mammal survey and assessment methods. A.A. Balkema, Rotterdam, The Netherlands.

Goudie R.I. and C.D. Ankney. 1986. Body size, activity budgets, and diet of sea ducks wintering in Newfoundland. Ecology 67:1475–1482

Grand, J.B. and P.L. Flint. 1997. Productivity of nesting spectacled eiders on the Lower Kashunuk River, Alaska. The Condor 99:926–932.

Grand, J.B., P.L. Flint, and M.R. Petersen. 1998. Effect of lead poisoning on spectacled eiders survival rates. Journal of Wildlife Management 62:1103–1109.

Gray, L.M. and D.S. Greeley. 1980. Source level model for propeller blade rate radiation for the world's merchant fleet. Journal of the Acoustical Society of America 67:516–522.

Green, G.A., and J.J. Brueggeman. 1991. Sea otter diets in a declining population in Alaska. Marine Mammal Science 7:395-401.

Greenlaw, C.F., D.V. Holliday, R.E. Pieper, and M.E. Clark. 1988. Effects of airgun energy releases on the northern anchovy. Journal of the Acoustical Society of America 84:S165.

Hamer, T.E. and S. K. Nelson. 1995. Characteristics of Marbled Murrelet nest trees and nesting stands. Pg. 69-82 *In*: Ralph, C.J. (ed.), Ecology and conservation of the Marbled Murrelet. U.S. Forest Service, Albany, California.

Hasegawa, H. and A.R. DeGange. 1982. The Short-tailed Albatross, *Diomedea albatrus*: its status, distribution and natural history. American Birds 6:806-814.

Heath, J.P., H.G. Gilchrist, and R.C. Ydenberg. 2007. Can dive cycle models predict patterns of foraging behaviour? Diving by common eiders in an Arctic polynya. Animal Behaviour 73:877–884.

Hills, S., and J.R. Gilbert. 1994. Detecting Pacific walrus population trends with aerial survey —a review. Transactions North American Wildlife and Natural Resource Conference.

Hirsch, K.V., D.A. Woodby, and L.B. Astheimer. 1981. Growth of a nestling Marbled Murrelet. The Condor 83:264-265.

Holland, L.E. 1986. Effects of barge traffic on distribution and survival of ichthyoplankton and small fishes in the upper Mississippi River. Trans. Am. Fish. Soc. 115:162-165.

Jay, C.V., and S. Hills. 2005. Seasonal haul-out use and offshore foraging areas of walruses in Bristol Bay, Alaska. Arctic 58:192–202.

Jefferson T.A., P.J. Stacey, R.W. Baird. 1991. A review of killer whale interactions with other marine mammals: predation to co-existence. Mammal Review 21:151–180.

Johnson, S.R. and D.R. Herter. 1989. The birds of the Beaufort Sea. BP Exploration (Alaska), Inc., Anchorage, Alaska.

Jones, R.D., Jr. 1965. Returns of Steller's Eiders banded in Izembek Bay, Alaska. Wildfowl 16:83-85.

Kastelein, R.A., P. Mosterd, B. van Santen, M. Hagedoorn, and D. deHaan. 2002. Underwater audiogram of a Pacific walrus (*Odobenus rosmarus divergens*) mea- sured with narrow-band frequency-modulated signals. Journal of the Acoustical Society of America 112:2173-2182.

Kastelein, R.A., J.L. Dubbeldam, M.A.G. de Bakker, and N.M. Gerrits. 1996. The Anatomy of the walrus head *Odobenus rosmarus*. IV. The ears and their function in aerial and underwater hearing. Aquatic Mammals 22:95–125.

Kenyon, K.W. 1969. The sea otter in the Eastern Pacific Ocean. Dover Publications, New York. 352 pp.

Kertell, K. 1991. Disappearance of the Steller's eider from the Yukon-Kuskokwim Delta, Alaska. Arctic 44:177-187

Kreuder, C., M.A. Miller, D.A. Jessup, L.J. Lowenstein, M.D. Harris, J.A. Ames, T.E. Carpenter, P.A. Conrad, and J.A.K. Mazet. 2003. Patterns of mortality in southern sea otters (*Enhydra lutris nereis*) from 1998-2001. Journal of Wildlife Diseases 39:495-509.

Kryukova, N.V., E.P. Kruchenkova, and D.I. Ivanov. 2012. Killer whales (*Orcinus orca*) hunting for walruses (*Odobenus rosmarus divergens*) near Retkyn Spit, Chukotka. Biology Bulletin 39:768–778.

Larned, W.W. and T. Tiplady. 1996. Distribution and abundance of sea ducks in Kuskokwim Bay, Alaska, September 1996. Unpublished Report. U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, Alaska, USA.

Larned, W., R. Stehn, and R. Platte. 2011. Waterfowl breeding population survey Arctic Coastal Plain, Alaska 2010. Unpublished report. U.S. Fish and Wildlife Service, Anchorage, AK. 52 pp.

Larned, W., R. Stehn, and R. Platte. 2012. Waterfowl breeding population survey, Arctic Coastal Plain, Alaska, 2011. Unpublished Report, U.S. Fish and Wildlife Service, Anchorage, AK. 51 pp.

Laubhan, M.K. and K.A. Metzner. 1999. Distribution and diurnal behavior of Steller's eiders wintering on the Alaska Peninsula. The Condor 101:694-698.

Leighton, F.A. 1991. The Toxicity of Petroleum Oils to Birds: An Overview in The Effects of Oil on Wildlife: Research, Rehabilitation and General Concerns. White, J., Frink L. (eds.) IWRC, CA. pp. 43-57.

Levy, E.M. 1980. Oil pollution and seabirds: Atlantic Canada 1976-77 and some implications for northern environments. Marine Pollution Bulletin 11:51-56.

Lipscomb, Thomas P., Richard K. Harris, Alan H. Rebar, Brenda E. Ballachey, and Romona J. Haebler. 1994. "Pathology of Sea Otters." Marine Mammals and the Exxon Valdez. 1st ed. Ed. Thomas R. Loughlin San Diego: API, 1994. Pp. 265-80.

MacLean S.A. 2012. Establishing a Transit Corridor through the Round Island Walrus Habitat Protection Area – Scope, Purpose and Need of the Action. North Pacific Fishery Management Council. Round Island Transit Corridor. 7 pp.

Madsen, P.T., M. Wahlberg, J. Tougaard, K. Lucke and P. Tyack. 2006. Wind turbine underwater noise and marine mammals: implications of current knowledge and data needs. Marine Ecology Progressive Series 309:279-295.

Malme, C.I., P.R. Miles, C.W. Clark, P. Tyack, and J.E. Bird. 1984. Investigations of the potential effects of underwater noise from petroleum industry activities on migrating gray whale behavior. Phase II: January 1984 migration (BBN Report No. 5586; NTIS PB86-218377). Report from Bolt Beranek and Newman Inc. for U.S. Minerals Management Service, Anchorage, AK.

Marks, D.K. and N.L. Naslund. 1994. Sharp-shinned hawk preys on a marbled murrelet nesting in old-growth forest. Wilson Bulletin 106:565-567.

Mate, B.R., K.M. Stafford, and D.K. Ljungblad. 1994. A change in sperm whale (*Physeter macrocephalus*) distribution correlated to seismic surveys in the Gulf of Mexico. Journal of the Acoustical Society of America 96:3268–3269.

McKenna, M.F., D. Ross, S.M. Wiggins, and J.A. Hildebrand. 2012. Underwater radiated noise from modern commercial ships. Journal of the Acoustical Society of America 131:92-103.

McShane L.J., J.A. Estes, M.L. Riedman, and M.M. Staedler. 1995. Repertoire, structure and individual variation of vocalizations in the sea otter. Journal of Mammalogy 76:414–427.

Melvin, E.F., J.K. Parrish, K.S. Dietrich, and O.S. Hamel. 2001. Solutions to seabird bycatch in Alaska's demersal longline fisheries. Washington Sea Grant Program. Project A/FP-7. http://wsg.washington.edu/communications/online/seabirds/seabirdpaper.html

Metzner, K.A. 1993. Ecological strategies of wintering Steller's Eiders on Izembek Lagoon and Cold Bay, Alaska. M.S. thesis, University of Missouri, Columbia, MO. 193 pp.

Miles, P.R., C.I. Malme, and W.J. Richardson. 1987. Prediction of drilling site-specific interaction of industrial acoustic stimuli and endangered whales in the Alaskan Beaufort Sea, BBN Report No. 6509, OCS Study MMS 87-0084. Reb. From BBN Labs Inc., Cambridge, MA, for U.S. Minerals Managements Service, Anchorage, AK. NTIS PB88-158498.

Murie, O.J. 1959. *Diomedea albatrus*: short-tailed albatross. *In*: Murie, O.J. and V.B. Scheffer (Eds.). Fauna of the Aleutian Islands and Alaska Peninsula. North American Fauna 61:36-39.

National Research Council (NRC). 2003. Ocean noise and marine mammals. Washington DC: National Academies Press. 617 pp.

Nelson, S.K. and T.E. Hamer. 1995. Nesting biology and behavior of the Marbled Murrelet. Ecology and Conservation of the Marbled Murrelet. *In*: Ralph, C. John; Hunt, G.L.; Raphael, M.G.; Piatt, J.F. eds. Ecology and Conservation of the Marbled Murrelet. USDA Forest Service, Pacific Southwest Research Station, General Technical Report, PSW-GTR-152.

Nelson, S.K. 1997. Marbled Murrelet (*Brachyramphus marmoratus*). Pg. 1-32 *In*: Poole, A, Gill, F. (ed.), The Birds of North America, No. 276. The Academy of Natural Sciences, Philadelphia and The American Ornithologists' Union, Philadelphia and Washington, DC.

Ober, H.K. 2013. Effects of oil spills on marine and coastal wildlife. University of Florida IFAS Extension Publication #WEC285. 4 pp.

Odom, M.C., D.J. Orth, and L.A. Nielsen. 1992. Investigation of barge-associated mortality of larval fishes in the Kanawha River. Virginia Journal of Science 43:41-45.

O'Hara, P.D. and L.A. Morandin. 2010. Effects of sheens associated with offshore oil and gas development on the feather microstructure of pelagic seabirds. Marine Pollution Bulletin 60:672-678.

Ouellet, J-F, C. Vanpé, M. Guillemette. 2013. The Body Size-Dependent Diet Composition of North American Sea Ducks in Winter. PLoS ONE 8(6):e65667.

Papanikolaou, A., E. Eleftheria, A. Aimilia, A, Seref, T. Cantekin, D. Severine, and M. Nikos. 2006. Impact of Hull Design on Tanker Pollution. Proceedings of the Ninth International Marine Design Conference, Ann Arbor, MI.

Petersen, M.R. 1980. Observations of wing-feather molt and summer feeding ecology of Steller's eiders at Nelson Lagoon, Alaska. Wildfowl 31:99-106

Petersen, M.R. 1981. Population, feeding ecology and molt of Steller's eiders. The Condor 83:256-262.

Petersen, M.R., B.J. McCaffery, and P.L. Flint. 2003. Post-breeding distribution of Long-tailed Ducks *Clangula hyemalis* from the Yukon-Kuskokwim Delta, Alaska. Wildfowl 54:103-113.

Petersen, M.R., D.C. Douglas, and D.M. Mulcahy. 1995. Use of implanted satellite transmitters to locate Spectacled Eiders at sea. The Condor 97:276-278.

Petersen, M.R., J.F. Piatt, and K.A. Trust. 1998. Foods of Spectacled Eiders *Somateria fischeri* in the Bering Sea, Alaska. Wildfowl 49:124–128.

Petersen, M.R., W.W. Larned, and D.C. Douglas. 1999. At–sea distribution of spectacled eiders: a 120–year–old mystery resolved. The Auk 116:1009–1020.

Petersen, M.R., J.B. Grand, and C.P. Dau. 2000. Spectacled Eider (*Somateria fischeri*). In: A. Poole and F. Gill, editors. The Birds of North America, No. 547. The Birds of North America, Inc., Philadelphia, PA.

Piatt, J.F., K.J. Kuletz, A.E. Burger, S.A. Hatch, V.L. Friesen, T.P. Birt, M.L. Arimitsu, G.S. Drew, A.M.A. Harding, and K.S. Bixler. 2006a. Status Review of the Marbled Murrelet (*Brachyramphus marmoratus*) in Alaska and British Columbia. Open-File Report 2006-1387. U.S. Geological Survey.

Piatt, J.F., J. Wetzel, K. Bell, A.R. DeGange, G.R. Balogh, G.S. Drew, T. Geernaert, C. Ladd, and G.V. Byrd. 2006b. Predictable hotspots and foraging habitat of the endangered short-tailed albatross (*Phoebastria albatrus*) in the North Pacific: implications for conservation. Deep Sea Research II 53:387-398.

Platte, R.M. and R.A. Stehn. 2011. Abundance and trend of waterbirds on Alaska's Yukon–Kuskokwim Delta coast based on 1988 to 2010 aerial surveys. Unpublished report, U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, Alaska. April 29, 2011. 43 pp.

Ports and Waterways Safety Assessment. 2006. Workshop Report: Aleutian Islands. 41 pp. Online at: http://www.aleutiansriskassessment.com/documents/aleutian_islands_finalrpt.pdf

Quakenbush, L.T. and J. Cochrane. 1993. Report on the conservation status of the Steller's eider (*Polysticta stelleri*), a Candidate Threatened and Endangered Species. U.S. Fish and Wildlife Service, Anchorage, Alaska. 26 pp.

Quakenbush, L.T. and R.S. Suydam. 1999. Periodic non–breeding of Steller’s eiders near Barrow, Alaska, with speculation on possible causes. Pages 34–40 *in* R.I. Goudie, M.R. Petersen, and G.J. Robertson, editors. Behavior and ecology of sea ducks. Occasional Paper Number 100. Canadian Wildlife Service, Ottawa.

Quakenbush, L.T., R.H. Day, B.A. Anderson, F.A. Pitelka, and B.J. McCaffery. 2002. Historical and present breeding season distribution of Steller’s eiders in Alaska. Western Birds 33:99-120.

Richardson, W.J., C.R. Greene, Jr., C.I. Malme, and D.H. Thomson. 1995. Marine Mammals and Noise. Academic Press, San Diego. 576 pp.

Romero L.M., J.M. Dickens, and N.E. Cyr. 2009. The reactive scope model – a new model integrating homeostasis, allostasis and stress. Hormonal Behavior 55:375–389.

Rosenberg, D.A., M.J. Petrula, D. Zwiefelhofer, T. Holmen, D.D. Hill, and J.L. Schamber. 2011. Seasonal movements and distribution of Pacific Steller’s eiders (*Polysticta stelleri*). Final Report. Alaska Department of Fish and Game, Division of Wildlife Conservation, Anchorage, Alaska. 44 pp.

Saricks, C.L. and M.M. Tompkins. 1999. State-Level Accident Rates of Surface Freight Transportation: A Reexamination. Argonne National Laboratory publication ANL/ESD/TM-150. 62 pp.

Sheffield, G.G., F.H. Fay, H. Feder, and B.P. Kelly. 2001. Laboratory digestion of prey and interpretation of walrus stomach contents. Marine Mammal Science 17:310–330.

Sheffield G. and J.M. Grebmeier. Pacific walrus (*Odobenus rosmarus divergens*): differential prey digestion and diet. 2009. Marine Mammal Science 25:761–777.

Schusterman, R.J. and C. Reichmuth. 2008. Novel sound production through contingency learning in the Pacific walrus (*Odebenus rosmarus divergens*). Animal Cognition 11:319-327.

Simmonds, M., S. Dolman, and L. Weilgart. 2004. Oceans of Noise. Science report prepared by the Whale and Dolphin Conservation Society (WDCS). Chippenham, United Kingdom. 168 pp.

Simons, T. R. 1980. Discovery of a ground-nesting Marbled Murrelet. The Condor 82:1–9.

Solovieva, D. 1997. Timing, habitat use and breeding biology of Steller's Eiders in the Lena Delta, Russia. Pp. 35–39, in S. Phil and T. Fox, eds. Wetlands International Seaduck Specialist Group Bulletin No. 7.

Southall, B. L., R.J. Schusterman, and D. Kastak. 2000. Masking in three pinnipeds: Underwater, low-frequency critical ratios. Journal of the Acoustical Society of America 108:1322–1326

Speckman S.G., V. Chernook, D.M. Burn, M.S. Udevitz, A.A. Kochnev, A. Vasilev, *et al.* 2011. Results and evaluation of a survey to estimate Pacific walrus population size, 2006. Marine Mammal Science 27:514–553.

Stehn R.A., C.P. Dau, B. Conant, and W.I. Butler, Jr. 1993. Decline of Spectacled Eiders Nesting in Western Alaska. Arctic 46:264-277.

Stehn, R., W. Larned, R. Platte, J. Fischer, and T. Bowman. 2006. Spectacled eider status and trend in Alaska. U.S. Fish and Wildlife Service, Anchorage, Alaska. Unpublished Report. 17 pp.

Stemp, R. 1985. Observations on the effects of seismic exploration on seabirds, pp. 217- 233. *In*: G.D. Greene, F.R. Engelhardt & R.J. Paterson (eds), Proceedings of the Workshop on Effects of Explosives Use in the Marine Environment, January 29-31, 1985, Halifax. Canada Oil and Gas Lands Administration, Environmental Protection Branch, Technical Report No. 5.

Stirling, I. 2011. Polar Bears: The Natural History of a Threatened Species. Fitzhenry and Whiteside. Markham, ON. 334 pp.

Strachan, G., M. McAllister, and C.J. Ralph. 1995. Marbled Murrelet at-sea and foraging behavior. Pg. 247–254 *In*: Ralph, C.J., Hunt, G.L. Jr, Raphael, M.G. & Piatt, J.F. (Eds). Ecology and conservation of the Marbled Murrelet. [General Technical Report PSW-GTR- 152] Albany, CA: US Department of Agriculture, Forest Service, Pacific Southwest Research Station.

Suryan, R.M., F. Sato, G.R. Balogh, K.D. Hyrenbach, P.R. Sievert, and K. Ozaki. 2006. Foraging destinations and marine habitat use of short-tailed albatross: A multi-scale approach using first-passage time analysis. Deep-Sea Research II 53:370–386.

Suryan, R.M., K.S. Dietrich, E.F. Melvin, G.R. Balogh, F. Sato, and K. Ozaki. 2007a. Migratory routes of short-tailed albatrosses: Use of exclusive economic zones of North Pacific Rim countries and spatial overlap with commercial fisheries in Alaska. Biological Conservation 137:450-460.

Suryan, R.M., G.R. Balogh, and K.N. Fischer. 2007b. Marine Habitat Use of North Pacific Albatross during the Non-breeding Season and Their Spatial and Temporal Interactions with Commercial Fisheries in Alaska. North Pacific Research Board Project 532 Final Report. 69 pp.

Therrien, S.C. 2014. In-air and underwater hearing of diving birds. PhD Dissertation. University of Maryland, College Park.

Thomas N. and R.A. Cole. 1996. The Risk of Disease and Threats to the Wild Population. Endangered Species Update 13:23-27.

Transportation Research Board (TRB). 2008. Rick of Vessel Accidents and Spills in the Aleutian Islands: Designing a Comprehensive Risk Assessment. TRB Special Report 293

Turnpenny, A.W.H. and J.R. Nedwell. 1994. The effects of marine fish, diving mammals and birds of underwater sound generated by seismic surveys. Subacoustech Report FCR 089/94. Available from: www.subacoustech.com.

Udevitz, M.S., J.R. Gilbert, and G.A. Fedoseev. 2001. Comparison of method used to estimate numbers of walruses on sea ice. Marine Mammal Science 17:601-616.

U. S. Fish and Wildlife Service. 1994. Conservation Plan for the Polar Bear in Alaska. Unpubl. Rept. Marine Mammals Management, U.S. Fish and Wildlife Service, Anchorage, AK. 79 pp.

U.S. Fish and Wildlife Service. 1997. Recovery plan for the threatened marbled murrelet (*Brachyramphus marmoratus*) in Washington, Oregon, and California. U.S. Fish and Wildlife Service, Portland, Oregon. 203 pp.

U.S. Fish and Wildlife Service. 2001. Endangered and Threatened Wildlife and Plants; Final determination of critical habitat for the Alaska–breeding population of the Steller's eider. Final rule. Published 2 February 2001 by the U.S. Fish and Wildlife Service. Federal Register 66:8849–8884.

U.S. Fish and Wildlife Service. 2002. Steller's Eider Recovery Plan. Fairbanks, Alaska.

U.S. Fish and Wildlife Service. 2008. Short-tailed Albatross Recovery Plan. Anchorage, AK. 105 pp.

U.S. Fish and Wildlife Service. 2009. Pacific Walrus (*Odobenus rosemarus divergens*). 2 pp.

U.S. Fish and Wildlife Service. 2011. Threatened and Endangered Species, Short-Tailed Albatross (*Phoebastria albatrus*). 2 pp.

U.S. Fish and Wildlife Service. 2013. Draft Revised Northern Sea Otter (*Enhydra lutris kenyoni*): Southwest Alaska Stock Assessment. Marine Mammals Management Office, Region 7, Anchorage, Alaska. 21 pp.

Van Dorp, J.R. and J. Merrick. 2014. Final Report: VTRA 2010: Preventing oil spill from large ships and barges in northern Puget Sound & Strait of Juan de Fuca. The George Washington University report to Puget Sound Partnership. 166 pp.

Vang Hirsh, K. 1980. Winter ecology of sea ducks in the inland marine waters of Washington. MSc thesis, University of Washington.

Vermeer, K., K.H. Morgan, R.W. Butler, and G.E.K. Smith. 1989. Population, nesting habitat and food of Bald Eagles in the Gulf Islands. Pg. 123-130 *In*: The Status and Ecology of Marine and Shoreline Birds in the Strait of Georgia, British Columbia (K. Vermeer and R.W. Butler, Eds.). Canadian Wildlife Service Special Publication, Ottawa: Canadian Wildlife Service.

Ward, D.H., and R.A. Stehn. 1989. Response of Brant and Canada Geese to aircraft disturbance at Izembek Lagoon, Alaska. Final Rep. U.S. Fish and Wildlife Service, Alaska Fish and Wildlife Research Center, Anchorage, AK.

Warnock, N. and D. Troy. 1992. Distribution and abundance of spectacled eiders at Prudhoe Bay, Alaska: 1991. Unpublished report prepared for BP Exploration (Alaska) Inc., Environmental and Regulatory Affairs Department, Anchorage, Alaska, by Troy Ecological Research Associates (TERA), Anchorage, Alaska. 20 pp.

Wartzok, D. and D.R. Ketten. 1999. Marine Mammal Sensory Systems. Pg. 117-175 *In*: J. E. Reynolds III & S. A. Rommel (eds) Biology of Marine Mammals. Smithsonian Institution Press, Herndon, Virginia.

Washington Department of Ecology. 2014. VEAT 2013. Ecology Publication 14-8-004. 5 pp.

Washington Department of Fish and Wildlife (WDFW). 2014. Marbled Murrelet Population Trends. Accessed at: http://wdfw.wa.gov/conservation/research/projects/seabird/marbled_murrelet_population/

Watkins, W.A, and W.E. Scheville. 1975. Sperm whale react to pingers. Deep Sea Research 22:123-129.

Weilgart, L.S. 2007. The impacts of anthropogenic ocean noise on cetaceans and implications for management. Canadian Journal of Zoology 85:1091–1116.

Wilson, H.M., T.D. Bowman, W.W. Larned, and J.B. Fischer. 2012. Testing the feasibility and effectiveness of a fall Steller's eider molting survey in southwest Alaska. Unpublished Report. USFWS, Migratory Bird Management, Anchorage Alaska. http://alaska.fws.gov/mbsp/mbm/waterfowl/surveys/pdf/swsteimolt.pdf

Wolt, R.C., F.P. Gelwick, F. Weltz, and R.W. Davis. 2012. Foraging behavior and prey of sea otters in a soft- and mixed-sediment benthos in Alaska. Mammal Biology 77:271-280.

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